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technology, trends, products, and solutions for forensic professionals

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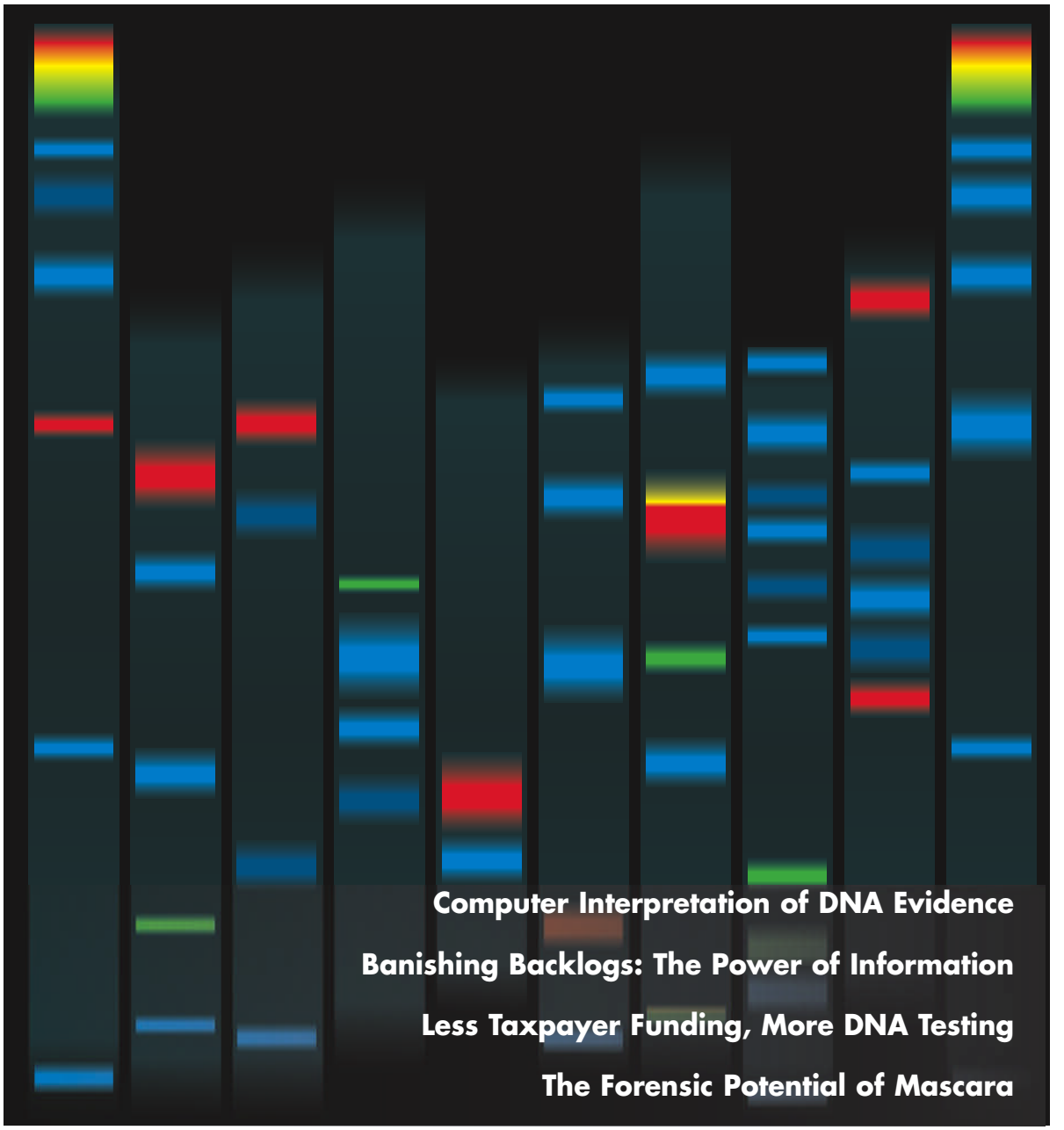

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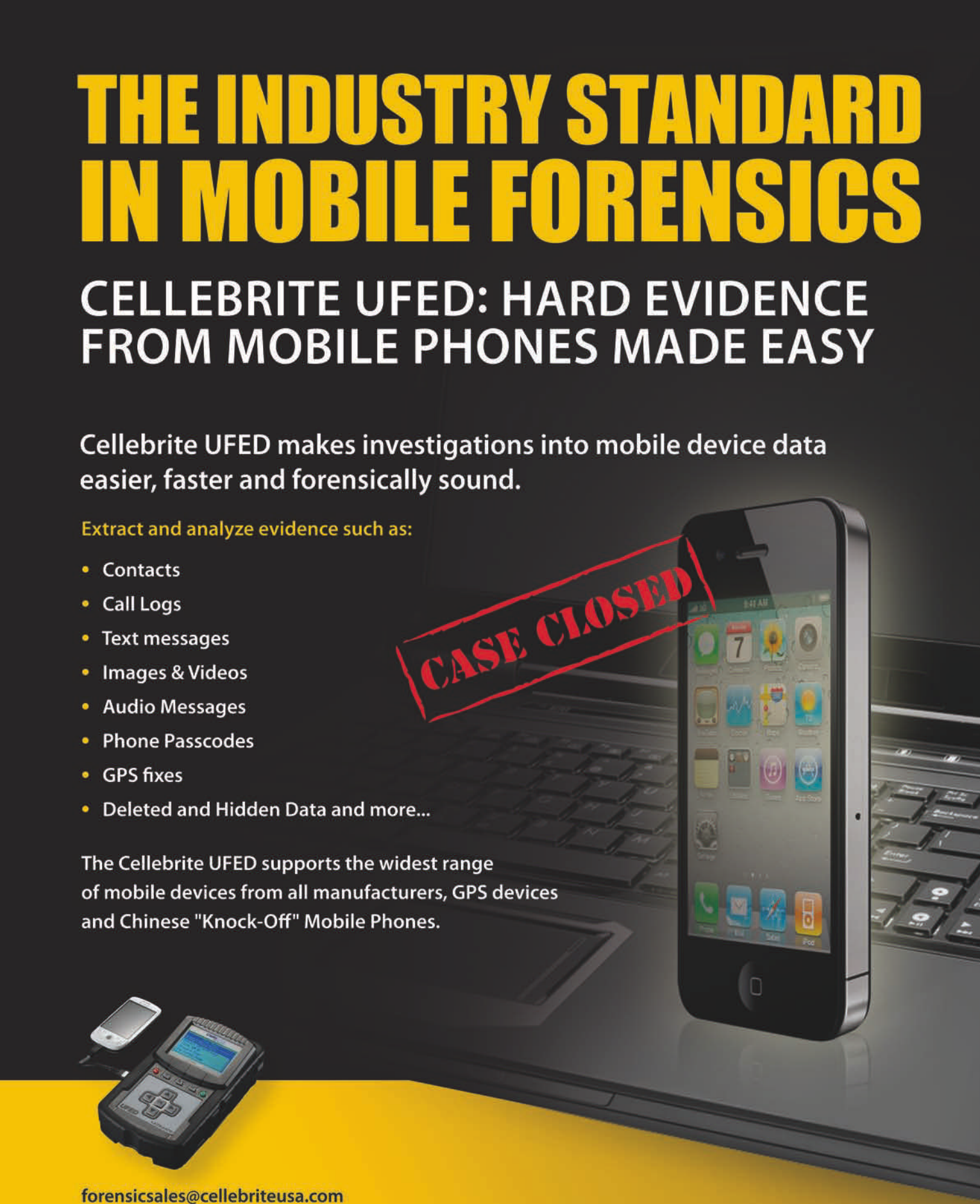

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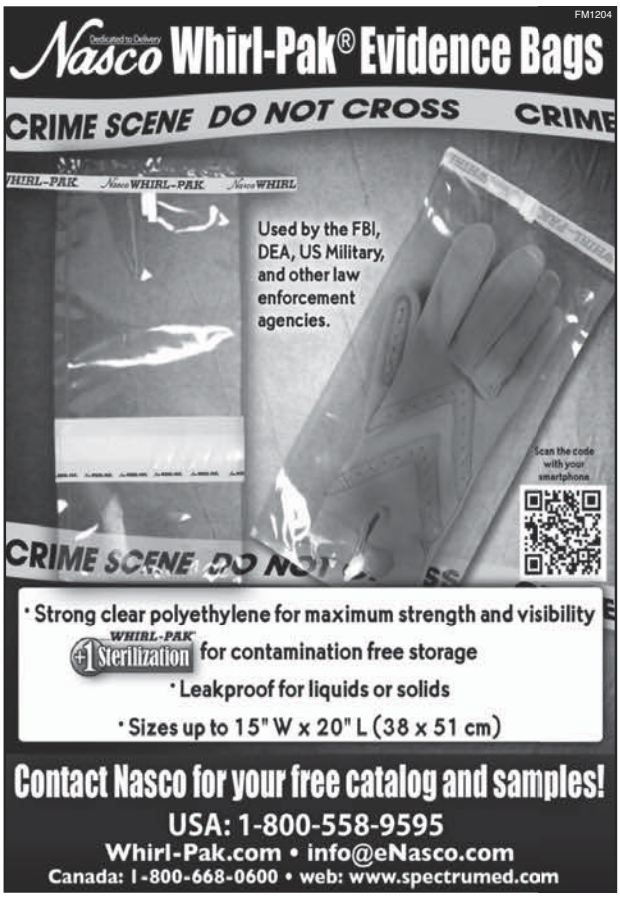
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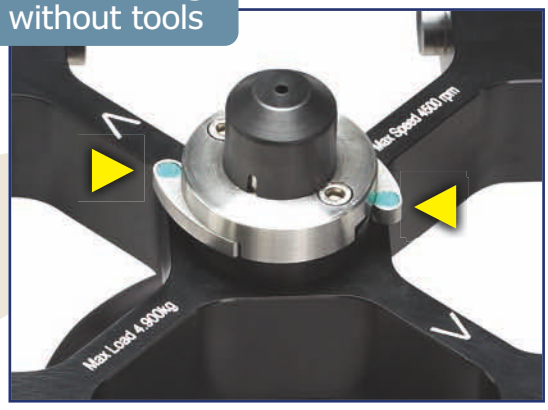

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point of view

Steve Renteria, Ron Becker, and Cortney Boccardi

Taking the Crime Scene to the Scientists: Real World Training for Forensic Scientists

Places like The Franklin Institute in Philadelphia, the Buffalo Museum in Buffalo, and others provide the public with the Crime Scene Investigation Experience they desire, giving them a closer look at how forensic science impacts our daily lives. One of the main purposes of these exhibits is to educate and promote public awareness of what modern forensic science is in real life. Forensic scientists also need a dose of yearly education in order to stay informed on modern forensic science and the advances that are evaluated by their peers. Many forensic laboratories these days take one of a few roads to providing their scientists and supervisors exposure to the required continuing education (CE): 1) Bring an expert in the forensic field into the laboratory to train the entire laboratory staff (most beneficial because it allows the entire laboratory to fulfill their CE requirements). 2) Send a few lab members to a regional or national conference (cost limits the number of people sent for CE). 3) Utilize the free training that comes with the purchase of a new instrument or other technology as CE credits. (This option is not always beneficial because if the training is less than 8 hours, the CE required credits are still not fulfilled. Additionally, only a select number of lab members can attend this training, ~5–15.) The forensic community is limited in the amount of funding available for keeping forensic scientists well educated on global initiatives in forensics today. Often laboratories in the U.S. rely on state or local funding in order to bring continuing education to their lab, whether there are 15 or 150 scientists in the laboratory. Due to the expense of larger regional conferences, many institutions can only send 1–2 people to a conference.

Let's face it, there are only so many statistics classes you can take! Most forensic scientists are happy to get a forensic expert to talk to them about forensic subject matter to further their knowledge about what they are doing in their laboratories. Ideally, hands-on experience along with well-designed lectures from these experts would comprise the total learning experience.

Friends of the Crime Lab and the Guam Community College have taken this educational idea and designed a CSI summit that takes past, present, and future forensic scientists and provides them with hands-on as well as lecture style training in order to combine the information necessary in forensics today. Here's a look at a couple of their specialties.

Under Water Crime Scene Analysis

Leaving Honolulu for the Guam Community College/Friends of the Crime Lab Forensic Symposium found me dragging an extra seventy pound bag of equipment that the airline was only too happy to charge me for. When you carry an underwater investigation workshop on the road, it takes lots of equipment: search lines, dive harnesses, mesh body bags, and all the associated hardware which included carabineers and snap shackles. The trip was uneventful but for the day lost crossing the international dateline.

The event planners had me working the next day. A class of regional law enforcement met the first morning. I fear that most thought this class would be similar to their previous scuba classes; they were in for a surprise. We were about to embark upon a journey that departed from standard scuba instruction in some significant ways.

The first day dealt with the evidentiary foundations of underwater evidence recovery and crime scene processing. They learned that we package all evidence from water, in the water. Marine archaeologist place all their artifacts in the water in which they are found, and if it works for them it will work for us. We talked about possible forensic evidence and its survival underwater, including:

- The recent work on salt etched fingerprints on cartridge cases.
- Back spatter on firearms
- Fingerprints on and in firearms and on automobiles
- Processing submerged vehicles and raising them to the surface
- Body sink rates (how to calculate how far a body may float downstream before reaching the bottom)
- Processing a mass disaster underwater crime scene (passenger aircraft crashes)

The second day covered the operational aspect of evidence recovery diving. We talked about tethered diving and its departure from standard scuba procedure. We covered packaging underwater evidence, bagging bodies, and commu-

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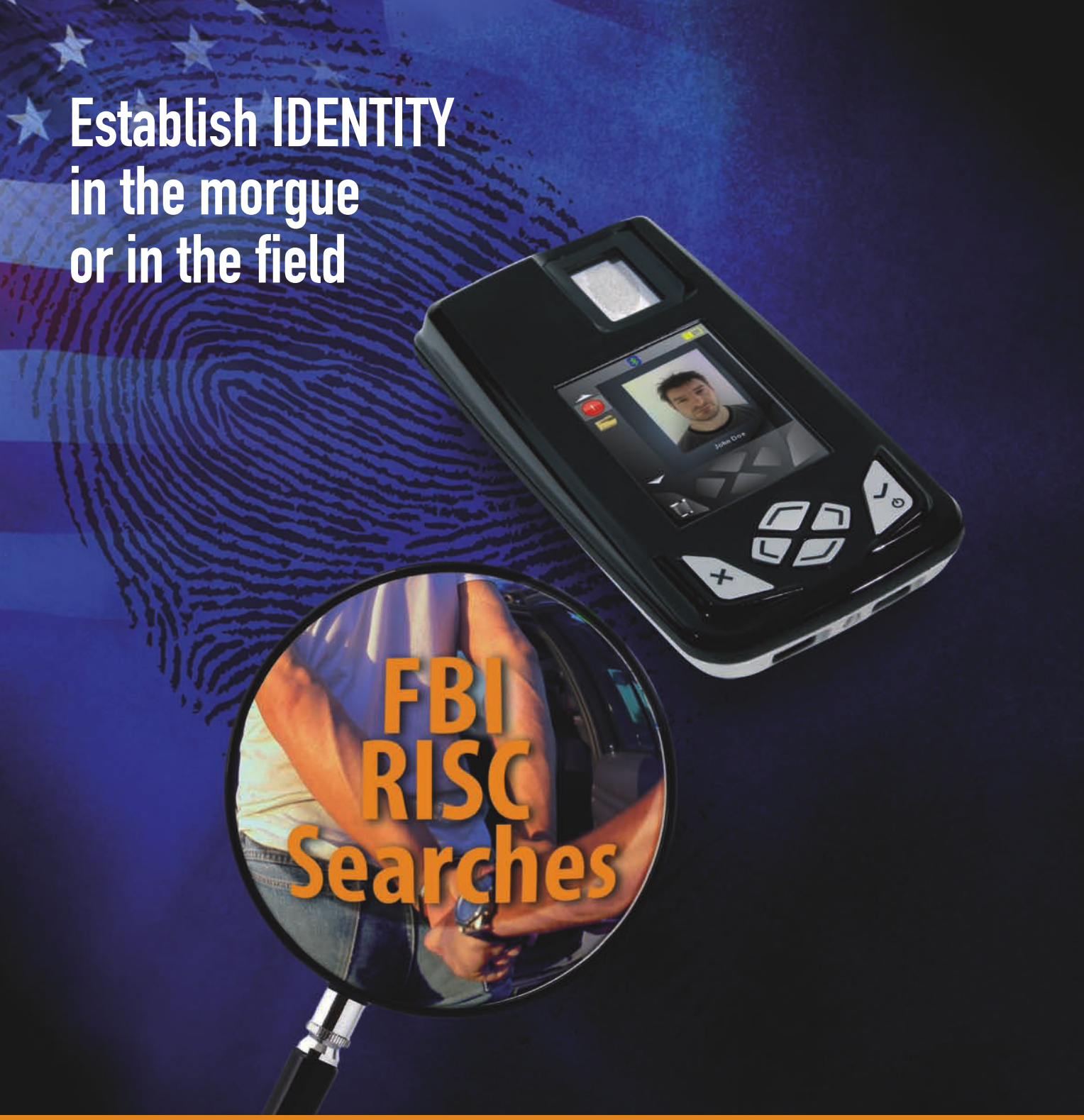

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nicating with the line tender via line tugs. We talked about underwater measurements and crime scene sketches, and we discussed emergency procedures and team composition and roles.

We spent the following day at Gab Gab beach on the Guam Naval Base. Each participant had to demonstrate proficiency in conducting a shore-based search, maintaining search line integrity, and bagging a body: first with the use of sight, then with their face masks blacked out. The work we do is often called "black water" diving in that most of what criminals dispose of, they dispose of in very nasty places. Hence, the need for blacked out face masks.

The last day was the final examination. The students formed four teams and were dispatched to a scene where they were informed that a witness saw someone throw a gun into the water. It was their responsibility to interview the witness, conduct the dive briefing, select the appropriate search pattern, and to deploy, find, package, measure, and sketch the operation. Each diver on each team had to search before the firearm was discovered. It was hard work, but all felt they had accomplished something upon completing the final examination.

Teaching forensics without a lab is like teaching flying without an airplane. Many universities have jumped on the forensics bandwagon without the funding for necessary laboratory practice. Those in programs without practical labs cannot be as adequately prepared for the workplace as those who do. Poorly prepared forensic graduates reflect poorly on all of us.

Crime Scene Investigation and Data Analysis

Two cycles of mock scenes for 65 participants were set up for hands-on training. The first afternoon consisted of two hours of lectures. "DNA at Crime Scenes" was presented by Steve Renteria and "CSI Basics" was presented by Guam PD Officers Tommy Salas and Gil Mondia.

The next day, mock scenes were set up at the old barracks near the airport by Guam PD Criminalists. Five scenes were set up for the DNA CSI segment and two for Basic CSI. The participants were split up into smaller working groups and rotated though particular mock scenes with Guam PD staff available for assistance. The participants were tasked with using the tools they learned during the lectures the previous day to "work the scenes". They worked within their own break out groups

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to: 1) Document the scene (sketches). 2) Describe the evidence present at the scene. 3) Determine what items would be collected, what sections of the lab they would be submitted to, and what probative value the item would shed. 4) Work through possible theories of what may have occurred at the crime scene. The participants were shown how to use the KM presumptive test to conduct a chemical test for blood. Processing the Basic CSI scenes included sketching, measuring, photographing, and collecting latent prints.

The mock scenes include the use of pig blood (to mimic human blood) for creating bloodstain spatter patterns and the placement of blood on weapons and mock victims (mannequins). The scenes were constructed to cover various scenarios seen in actual crime scenes. They were designed to challenge the participants to think about not only what evidence was present, but also what was not present at the scene that may shed light on what occurred.

At the end of the training session each group presented their findings to the entire class. The team leader for each group talked about what items they would have collected and why, what the scene told them, and what they thought occurred.

When providing training on complicated subjects like crime scene processing, getting students involved in practicing the techniques in mock scenes is extremely beneficial. A lecture can be one dimensional, and it may be difficult for the student to grasp the entire picture. When the lecture is coupled with a mock crime scene, the student can put into practice the various techniques discussed and get a better understanding of how the techniques relate to each other in a real life situation.

As the Chinese Proverb states; "Tell me and I'll forget; show me and I may remember; involve me and I'll understand."

Mr. Renteria *has been working for the Los Angeles County Sheriff's Department since 1983. He performs DNA casework, is the DNA Technical Leader and CODIS Administrator, and is the Cold Hit Outcome Project (CHOP) coordinator for the Department.*

Professor Becker *is a tenured Professor at Chaminade University. As Chair of the Criminology and Criminal Justice Program since 2002, he has streamlined graduate and undergraduate curricula and created an on-line Masters of Criminal Justice Administration.*

Cortney Boccardi *is a Forensic Scientist at GE Healthcare. She has been working in the forensic DNA field for 12 years in both the government and commercial industry.*

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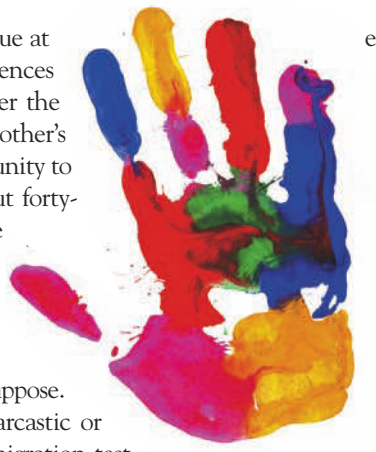

I had a great conversation with a colleague at the American Academy of Forensic Sciences meeting in Atlanta. We had spoken over the phone before and certainly knew of each other's work, but we never really had the opportunity to sit down and discuss issues before. About forty-five minutes into the conversation he finally says, "You know, you converse a lot differently than you write. What's up with that? Do you just get up sometimes in a bad mood and start writing?"

A humorous, albeit fair, question I suppose. Given recent, shall we say somewhat sarcastic or acerbic commentaries on issues like immigration testing (or the lack thereof), familial searching (or the lack thereof), legislation in South Africa (or lack thereof), and national arrestee testing (or lack thereof) I can understand his query.

To some extent, I assume that if you are reading this magazine you don't paint houses or sell cars or prepare taxes. If you are reading this magazine, it is probably because you are either a forensic scientist or police officer, lab manager or you may even be in the private sector at one of the leading forensic suppliers. In any event, most of you aren't happy with the status quo when it comes to saving people's lives. Me either.

That being said, it seems like poor form to spend less time acknowledging when we do, as a community, get it right. So let me take this opportunity.

According to the United Nations Office on Drugs and Crime, 161 countries are affected by human trafficking. The majority of those trafficking victims are between 18 and 24 years of age. To further characterize and quantify the crime, an estimated 1.2 million children are trafficked every year. And 95% of victims experience physical or sexual violence.

As defined by the United Nations, human trafficking involves, "an act of recruiting, transporting, transferring, harboring, or receiving a person through the use of force, coercion, or other means, for the purpose of exploiting them." But the more tangible human tragedy comes in the end purpose of the "trafficking" itself: sexual slavery, forced labor, illegal adoptions, etc. A particularly insidious example of human trafficking comes in the context of mass human tragedy.

DNA–Prokids

In 2004, Dr. Jose A. Lorente from the University of Granada (UGR), Genetic Identification Laboratory suggested the development of worldwide DNA registries consisting of parents with a missing or abducted child, homeless children found living on the street or in shelters, and children found in orphanages or illegal adoption centers. From this idea the UGR launched DNA-Prokids (Program for Kids Identification with DNA Systems). DNA-Prokids is an international humanitarian effort to help identify missing children in order to reunite abducted and homeless children with their parents and to provide law enforcement agencies a scientific methodology to help deter the human trafficking of children. Initial funding for DNA-Prokids was provided to the UGR by the Spanish Government, the Government of the State of Andalusia, and donations from private companies and foundations within Spain. In 2009, Dr. Arthur Eisenberg and the University of North Texas Center for Human Identification (UNTCHI), Fort Worth, Texas, partnered with the UGR to further the development and expansion of DNA-Prokids throughout the world. The UGR continues to act as the headquarters for DNA-Prokids and along with UNTCHI supports the establishment of the program within all participating countries. The UNTCHI, with its high throughput processing capability, will assist countries in the generation of DNA profiles as well as spearhead the development of the international databases to facilitate comparisons and help identify familial relationships.

The value of DNA-Prokids, and thus the value of expanded international applications of forensic DNA technology, can be seen in a simple but poignant example from

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a natural disaster of epic proportions. In 2004, the Indonesian tsunami killed 230,000 people and left approximately 42,883 people missing. The tsunami took its heaviest toll in the Aceh region, where approximately 160,000 were killed. When the tsunami prompted 60 foot-tall waves, the town of Meulaboh disappeared and from then on became known as "ground zero." Thousands of bodies could not be identified. Meri Yulanda, an eight-year-old girl, was believed to be among them.

However seven years later, in late December of 2011, Meri appeared at a café in her home town in West Aceh telling anyone who would listen the only name she remembered "Ibrahim," her grandfather's name. Looking all of fifteen and not the eight-year-old who washed away, she brought with her a story in which mother nature's brutality would not be outdone by human nature's potential cruelty.

Meri had last been seen with her older sister atop a house when the waves hit the rooftop. Their father had dragged them there and told them to wait while he rescued their mother. Instead, he watched in horror as the house was destroyed by a wayward and out of control boat. And while Meri recalls none of the initial natural disaster, she does remember what happened afterward when she wound up in Banda Aceh, the province's largest city. For seven years there, she was bullied and beaten into street begging by her captor Fatima. She explained that she was forced to join dozens of tsunami orphans pleading for cash outside coffee shops and the city's grand mosque. One day, after beating her again, Fatima angrily divulged the name of Meri's hometown, telling her to leave since she failed to beg well enough. Using skills taught to her by a seasoned beggar, Meri found a mini-bus driver going to Meulaboh.

While her parents believed they recognized Meri thanks to a birthmark and a scar, it was the DNA test performed by the DNA-Prokids program that removed any doubt that Meri had at last returned home.

DNA-Prokids works quite literally in every corner of the world. But the logistics, the travel, the personnel, and all the other factors that go into that kind of work is not inexpensive. The primary funding for the further development and expansion of DNA-Prokids has been provided by an award in 2009 to UNTCHI from the Life Technologies Foundation. These funds are being used for: 1) the development and distribution of DNA kits to facilitate the collection of samples from: parents or families with a missing or abducted child; children found working in prostitution rings or performing forced labor in sweat shops; homeless children found living on the street or in shelters; and children found in orphanages or illegal adoption centers; 2) to support the DNA analysis of samples from those countries lacking processing capability; 3) the development and distribution of software to facilitate database construction and profile comparisons; 4) the development of a campaign to drive awareness and encourage participation in underdeveloped countries; and 5) to help define best practices for the establishment of DNA repositories for international adoptions to identify abducted children. The ultimate goal would be to provide the participating countries with the training and resources to directly process the DNA samples they collect and administer their own national databases in a manner that would facilitate international data searches.

Meri's story is just one of tens of thousands that exist throughout the world as an example of the horrors of human trafficking. DNA-Prokids provides an example that we possess the technology, the resources, and most importantly, the will to fight back hard against the some of the worst nature and human nature has to offer.

Chris Asplen *consults with local, state, and foreign governments and law enforcement agencies on the use of forensic DNA technology. He may be reached at casplen@gth-gov.com.*

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04/2012

Forensic Science in the Information Age

Reliable computer interpretation can address the scientific need for thorough, objective, and informative analysis of DNA evidence.

Mark W. Perlin, Ph.D., MD, Ph.D.

Forensic Identification

Ancient societies used distinguishing marks to identify people and their property. During the T'ang Dynasty, Chinese officials certified documents with handprints.[1] Babylonians in the pre-Islamic Sassanid Empire established ownership of lost items through identifying marks.[2] In the 19th century, more precise measurements of physical features[3] and fingerprints[4,5] enabled more accurate human identification and statistical association.[6]

The 20th century witnessed a flowering of diverse forensic modalities (hair, fiber, glass, ballistics, etc.) that could connect crime scene evidence with a suspect.[7] Investigative databases that could solve cold cases were established in the earliest decades for fingerprints in London and New York and evolved into DNA databases by the close of the century.[8] Today, the success of DNA identification,[9] coupled with outsized "CSI effect" expectations,[10] have instilled in the modern world a sense of forensic infallibility, with abiding faith in the power of DNA.

Great Expectations

There are many consumers of forensic information. Police investigate crimes, prosecutors present evidence that is weighed by judges and juries, while the public funds the forensic enterprise in order to secure better protection from crime. These societal consumers of crime lab information all assume that: a) the forensic evaluation process is thorough and objective, and b) the full measure of identification information has been accurately extracted from the available evidence. These are reasonable expectations. An incomplete or biased approach that discarded information might be ineffective (not find the right person), incorrect (implicate the wrong person), or unusable (inadmissible in court).

However, current forensic science practice does not always meet these expectations. The National Academy of Sciences (NAS) 2009 report on "strengthening forensic science" identified potential flaws or examiner bias in some methodologies.[11] Indeed, comparative bullet lead analysis was found to lack a sound scientific basis and is no longer used.[12] Since DNA evidence interpretation had not consistently accounted for natural data variation, the federal Scientific Working Group on DNA Analysis Methods (SWGDAM) issued new 2010 guidelines.[13] Recent studies report examination bias in DNA mixture interpretation[14] and a million-fold information loss in the human review of mixture data.[15,16]

A thorough and objective evaluation of evidence that yields all the data's identification information may be desirable, or even necessary, but is it feasible? Isn't a "match" between evidence and suspect inherently limited to just comparing the data features of these two items? And isn't this "match" unavoidably biased, since one of the two items is the suspect? If the items either fully "match" or they don't, how does one measure the amount of information?

Before the advent of computers and information theory, these might have been challenging questions. But in the modern age, the questions have workable, generally accepted answers. We next examine how information science can resolve these fundamental issues in forensic science.

Information Science

Computers and information theory were forged on the scientific battlefields of World War II. The earliest electronic computers used probabilistic search to solve the equations that helped build the atomic bomb.[17] Information theory and likelihood ratios (LR) cracked the German Enigma code, providing daily military intelligence on custom-built computers.[18] Scientific computing crunched raw data into the information that won the war, and ushered in our modern world.

Most people like certainty. During cross-examination, an expert witness wants solid fact to provide a shield of certainty against an onslaught of critical questioning. But science reasons from uncertain data, not blind faith, and so such certainty is illusory.

Uncertainty rules in nature. DNA differences provide abundant natural variation in biological populations, with no two (uncloned) individuals alike. Scientific data exhibit laboratory variation, with random fluctuations occurring between repeated experiments and seen within each measurement. In a random world, though, these same data are needed to reduce uncertainty and increase our rational belief in one hypothesis over another.

Uncertainty arises when there is more than one possible explanation. Our scientific belief in a particular explanation is its probability, a number between 0 and 1. An explanation's information is related to the reciprocal of its probability.

A rare event has a small probability, so its reciprocal gives a large information number, reflecting the considerable surprise experienced when the event happens. The occurrence of a common (high probability) event does not surprise us at all, and so its low information (the reciprocal of a high probability is a small number) indicates little or no surprise. Quantifying uncertainty through probability[19,20] provides the information needed to strengthen forensic science.

Identification Science

A modern identification science must be thorough, objective, and informative. These properties, which we now consider in turn, make scientific identification less susceptible to legal challenge.

A *thorough* evidence examination must use all the data. A "model" helps explain observed data. When data count up how much of a quantity is present, a quantitative model is needed to express those counts with numbers. Random variation is accounted for by the model's statistical component. A computer model uses probability to mathematically assess how well a proposed hypothesis actually explains the data.

Thoroughness also entails considering all possibilities. Deductive reasoning proceeds forward from a hypothesis to explain observed data. Inductive reasoning instead starts from the data, and infers causal hypotheses. This inverse reasoning (from data, back to hypothesis) is done with Bayes' theorem,[21] which assesses all possible hypotheses and calculates the probability of each one. Most real-world inductive problems (including forensic inference) are complicated and need a computer to solve their complex equations.

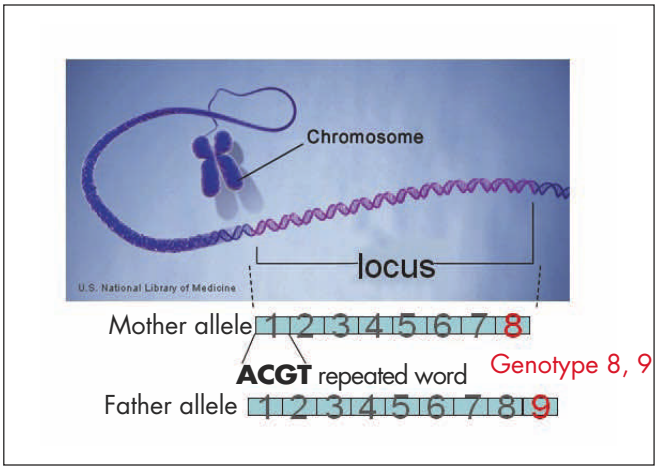
Chromosome
locus
U.S. National Library of Medicine
Mother allele 1 2 3 4 5 6 7 8
ACGT repeated word
Genotype 8, 9
Father allele 1 2 3 4 5 6 7 8 9

Figure 1: DNA genotype. A genetic locus has two DNA sentences, one from each parent. An STR allele is the number of repeated words. A genotype at a locus is a pair of alleles, as in the 8, 9 shown in the diagram. Since many alleles allow for a great many allele pairs, a person's genotype is relatively unique.

An *objective* assessment requires that the computer never see a suspect or defendant when evaluating evidence. That is, when the computer infers the probability of each hypothesis, its deliberation must be done without any knowledge of what the "answer" should be. Rather, the computer should reach its unbiased conclusions solely from the available evidence.

The hypotheses considered by the computer will ultimately be compared with known references. With ballistics evidence, for example, the striations and marks of a crime scene bullet can be explained as arising from the barrel of a particular firearm. The make and model of a firearm is a possible hypothesis for the bullet evidence. Thorough

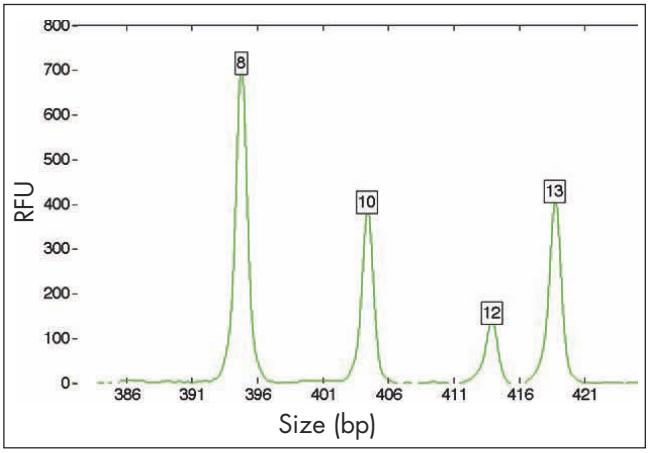

Figure 2: Mixture data. A mixture sample has genotype allele pairs from two or more contributors. Shown is a DNA signal (green curve) having four peaks at the Penta D locus. The horizontal x-axis indicates an allele's DNA molecule length, while the vertical y-axis measures a peak height that reflects the allele's DNA quantity.

inference considers all feasible firearm models, assigning each model a probability that accounts for its prevalence and how well it explains the bullet mark measurements. Performed objectively, only the bullet data is used.

When comparing evidence to a known suspect, we want to quantify the amount of information in a match. How much more does one hypothesis explain the evidence than alternative hypotheses? Equivalently,[22] how much more probable is a match between evidence and known than mere coincidence? This balance of probabilities is the match statistic (or "LR") that weighs the evidence supporting the hypothesis, relative to all other alternatives. In accordance with the Federal Rules of Evidence (FRE) Rule 403, LR match information is able to assess the probative value of a hypothesis and factor away prior prejudices.

Genotype Inference

The *genotype* is the central concept of DNA identity. At a genetic locus (some location on a chromosome), a person has two copies of DNA, one inherited from each parent (Figure 1). The DNA content is called an "allele". A person's genotype is their allele pair at a locus.

A genetic locus having very many alleles can help identify people. For example, 20 alleles lead to over 200 allele pairs for a genotype. Testing a dozen such loci leads to quintillions of possible genotypes, more than enough to statistically distinguish billions of people.

Human identification uses short tandem repeat (STR) alleles, DNA sentences of repeated short words. The number of repeated words determines the allele. An allele's DNA molecule can be amplified and sized on a DNA sequencer, producing an allele peak. An STR allele is specified by peak position, since molecule length is proportional to the number of repeats. The amount of allele DNA is proportional to peak height.

When the two alleles in a person's genotype are the same size, the data show one tall peak. With two different alleles, the data show two peaks. Inferring a genotype from reference data is easy, since there is only one allele pair explanation for the peak data. Starting from the hundreds of possible allele pairs in a population, reference data quashes that uncertainty down to a single answer, generating considerable identification information.

A DNA mixture contains two or more individuals. This combination of allele pairs from different people leads to evidence data more complex than just one or two peaks. Therefore, there is usually more than one genotype explanation, since different allele pair combinations can account for the peak data. These multiple explanatory possibilities create genotype uncertainty. DNA interpretation must thoroughly and objectively examine the mixture data, assigning accurate probabilities to genotype allele pair hypotheses.

Case Example

Two years ago in Stafford County, a Virginia woman awoke to find a man she knew on top of her. She screamed, he fled. DNA from her underpants showed a mixture containing multiple contributors (Figure 2). Comparison was made with the DNA of a sergeant from the nearby Quantico Marine base, but human review following the 2010 SWGDAM guidelines was inconclusive. The DNA evidence was therefore reinterpreted using a validated probabilistic genotyping system[15] in order to determine a match statistic.

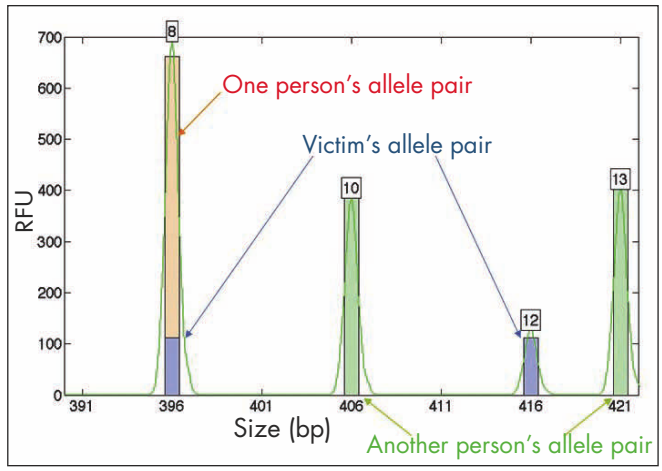

Figure 3: Genotype inference. The computer explores all possible genotype combinations, trying to explain the observed data peak pattern. Better explanations lead to a higher genotype probability. Shown is an explanation that combines different amounts of allele pairs (colored bars) from three contributors.

Starting from the Promega PowerPlex® 16 amplification signals stored in an Applied Biosystems 3100® sequencer file format, the DNA data was uploaded to a Cybergenetics TrueAllele® Casework interpretation computer system. The computer processed the evidence item's data under different scenarios: two versus three contributors, with or without assuming the victim was a contributor, and so on. To ensure objectivity, the computer was given no knowledge of the sergeant's genotype, and so the evidence examination was unbiased.

A thorough genotype explanation should account for the peak height data pattern observed at a locus. The computer can suggest an allele pair assignment for each contributing genotype. The software then expands the height of a contributor's allele pair in proportion to how much DNA came from that contributor. The computer adds up these weighted allele pair components to construct an allele peak pattern whose hills and valleys might explain the DNA data (Figure 3). Since "a better fit's more likely it", genotype values that form more explanatory patterns receive higher probability.

The computer thoroughly considered hundreds of thousands of genotype explanations. Those explanations that better explained the data conferred higher probability to their genotype allele pairs. Genotype possibilities that could not explain the data received very low probability. Intermediate genotype explanations

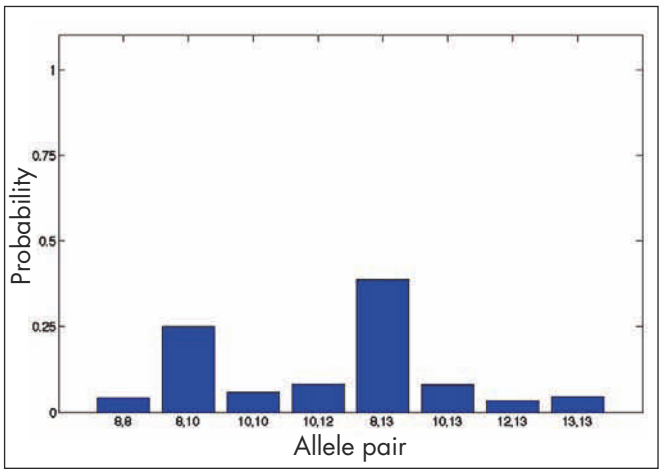

Figure 4: Genotype probability. The evidence genotype for one of the unknown contributor genotypes, objectively inferred without any knowledge of the suspect. Shown are probability bars for eight allele pairs that account for about 99% of the probability. Virtually no probability is assigned to the hundreds of other allele pair possibilities at this locus, since they cannot adequately explain the data. The data imposes a constraint that reduces the number of possible genotype values; fewer possibilities increases genotype information.

received intermediate probability. When done deliberating, the computer wrote into a database its inferred genotypes, providing a probability distribution for each locus and contributor (Figure 4).

The computer's objectively inferred mixture evidence genotype was then compared with the suspect's genotype. This comparison was done relative to a black population genotype (representing all conceivable alternative people) in order to form a match statistic. The LR match statistic reports on how much the evidence changed our belief from a random match to a specific suspect match. There was a four-fold gain in probability at the Penta D locus, as seen visually (Figure 5). Multiplying together the match scores at 15 genetic loci, and accounting for human relatedness, a match between the victim's underpants and the sergeant was 284 million times more probable than coincidence.

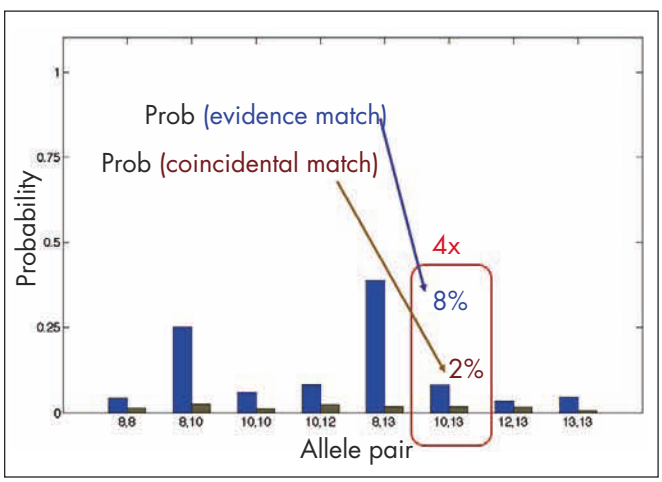

Figure 5: Match statistic. DNA match information tells us how much more the suspect matches the evidence than a random person. With computer inference done, we now note that the suspect's genotype at locus Penta D is the allele pair 10,13. The LR focuses our attention on just this one genotype value (red box), taking the ratio of the evidence genotype probability (8%) to the population genotype probability (2%). This ratio gives us a match statistic of 4, expressing the information gain from the Penta D locus data.

The computer's DNA mixture interpretation and reported match statistic were introduced as evidence at the court martial. The direct and cross-examination of the expert witness took under an hour. The defendant was found guilty on all charges and sentenced to three years in the brig and a dishonorable discharge from the Marine Corps.

Forensic Applications

Last year the author filed case reports with computer match statistics in over 75 criminal cases. The offenses include sexual assault, homicide, weapons or drug possession, bank robbery, and home invasion. Expert testimony was given in state, federal, military, and foreign courts. Most cases involved police or prosecutors needing a match statistic for arrest or court on DNA evidence where human review was inconclusive or unpersuasive. The DNA was usually crucial evidence, with the defendants typically convicted of their crimes. Several cases involved the defense assessing actual or post-conviction innocence.

The courts have accepted computer DNA evidence interpretation. The Pennsylvania appellate Superior Court upheld the 2009 *Commonwealth v. Kevin Foley* homicide conviction and computer admissibility in a published precedential ruling.[23] In the Real IRA Massereene Barracks attack, which killed two unarmed British soldiers, the Northern Ireland court admitted computer methodology into evidence and used the DNA match statistic in its ruling.[24] These legal precedents are based on extensive scientific validations of the probabilistic genotype method[15,16] and regulatory approval.[25] Computer interpretation is not novel, just a useful implementation based on established mathematics and science.

Highly informative computer-inferred evidence genotypes can help investigators find criminals and missing people. However, some government DNA databases institutionalize the low information yield of human interpretation methods. One crime lab study showed that out of fifty DNA mixtures, human review did not produce a match statistic on half the evidence items, whereas the computer succeeded every time. Other crime lab studies show that even when human review of mixture data does yield a match statistic, the computer's numbers are (on average) about a million times greater. More informative genotypes translate into a more powerful investigative database.

Investigative DNA databases of information-rich genotypes were used for identifying victim remains in the World Trade Center disaster.[26] The statistical computer inferred probabilistic genotypes from victim remains evidence, and from missing person kinship and personal effects data; the investigative database then compared these genotypes to form matches having LR statistics.[27] Probabilistic genotypes are written into the ANSI/NIST forensic

data exchange standards (sect. 18.020-18.021),[28] and are specifically allowed by SWGDAM interpretation guidelines (par. 3.2.2).[13]

Path Forward

An information age demands information. We expect a Google search to return thorough, objective, and informative results, using the best available probability computer model methods. Our human minds ask questions, and we rely on the computer to calculate the best answers. Whether cracking a code, diagnosing disease, piloting a plane, or working on Wall Street, our lives and livelihoods depend on computer thought. Apprehending criminals through forensic intelligence is no exception—we want the most informative computers working 24/7 to provide protection.

DNA laboratories are now bringing computers on board to extend their forensic examiners' analytic capability. A scientist can organize evidence and frame forensic questions; robots and computers can then automate the mechanics. A forensic scientist can incorporate informative DNA match statistics from complex mixture calculations into their case reports, and provide testimony in court. Experts excel at human activities, while computers are better calculators. Even before their crime labs deploy computer interpretation, police investigators and trial attorneys can rely on the private sector to deliver computer processing, case reports, and expert witness services.

The NAS report identified ways to strengthen forensic science. In addition to sound scientific data, the criminal justice system relies on thorough, objective, and informative interpretation of such data. DNA has paved the way once more and shown how reliable computer interpretation can address these scientific needs, complementing human cognition. Forensic science is now embracing the information age, extending the human mind with objective and informative computer solutions.

References can be found online at www.forensicmag.com/article/forensic-science-information-age.

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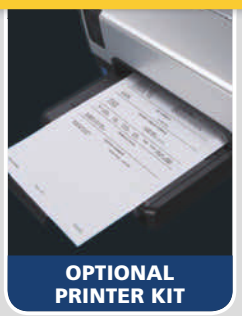

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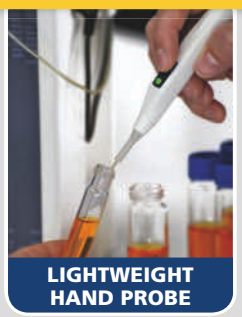

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The Power of Information

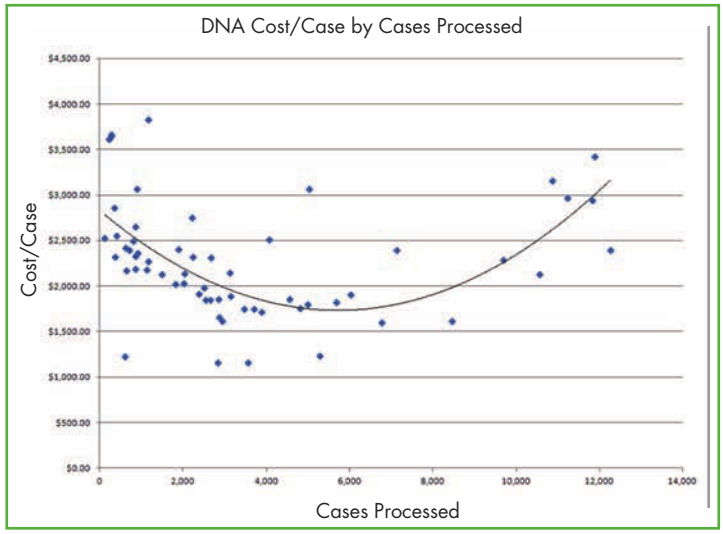
Banishing backlogs and budget cuts with "Foresight"

Dr. Tom S. Witt and Dr. Paul J. Speaker

Backlogs. Budget cuts. Legislative pressure to perform. The world of forensic science is fraught with challenges that extend beyond mere science. Increasingly, forensic labs are being asked to do more with less, a frustrating situation for professionals tasked with providing sensitive data that relies on quality testing. How can forensic professionals harness the performance data they need to both improve their own work and communicate their needs to a larger audience? Enter Foresight.

In 2003, the Quadrupol[1] study examined the practices of four European forensic labs in order to uncover inefficiencies and develop best practices. Building on that work, in 2006 West Virginia University began the Foresight project: a multi-year evaluation of budgetary and performance data from 15 forensic labs. Funded by a grant from the National Institute of Justice (NIJ), the intense study required participating labs to provide extensive data on every budget item associated with their lab plus share all casework. The goal was to evaluate a forensic lab much like we would any other economically driven business, but with one important difference. As public service entities, forensic labs are motivated by different incentives than a traditional market-based business. These labs were chasing performance, not profit, and being asked to do more and more work with far fewer resources. The question became one of economics and efficiency: How could the labs maximize output while minimizing staffing needs, test duplication, and other cost centers?

Today, with 64 ISO 17025:2005 and/or ASCLD/Lab Certified labs participating, the Foresight project can provide fairly specific answers to that question. These laboratories represent a broad spectrum that includes national, statewide, regional, and metropolitan jurisdictions; single laboratory and multi-facility systems; public and private labs; and participation from five continents. Based on caseload and financial information, the project offers insight into how many personnel are required for a "right-sized" organization. Study participants have used the Foresight performance tools to power through their backlogs in record time, and some have leveraged the data collected to fend-off budget cuts and even increase funding. Participants have also learned best practices from other participants, who were 'best in class.' Knowledge, in this case, truly is power: Power to serve more with less and power to communicate this enhanced performance to those responsible for approving ongoing, much-needed resources.



Right-sizing helps labs maximize output with the minimum required resources. As a lab's DNA cases expand, we've found bigger isn't always better. Building a second lab, rather than expanding the first, is sometimes a better solution.

Data Collection

As part of the Foresight research team, we owe quite a bit to our first group of participants. While today we use a powerful-but-simplified two-page data collection instrument we affectionately call "LabRAT" (Laboratory Reporting and Analysis Tool), in the beginning we asked our participating labs to provide pages upon

LabRAT
Tips for Enhanced Performance

From managers to budget committees to legislators, everyone loves useful data. Data simplifies decision-making. Foresight participants collect all sorts of data and enter it into a spreadsheet called "LabRAT." The formulas embedded within this powerful performance evaluation tool almost immediately provide Foresight participants with feedback they can use to enhance output in simple but meaningful ways. With so many labs participating, the Foresight project professionals at West Virginia University have learned a great deal about what it takes to be a high-performing lab.

1. Test to prosecutorial limits, not beyond. Examine your testing practices. Are there legacy protocols that are outdated? Are you testing to prosecutorial limits? Duplication is a good thing when it serves a purpose, but you can test too much. For example, one Foresight participant had a case involving 50 one-ounce bags of suspected cocaine. Rather than testing the contents of all 50 bags, they stopped after confirming the illegal contents of half of the bags, which carries the most severe penalty allowed in that state. Additional testing would only waste precious time and resources.

2. Experiment with flexible schedules and cross-training. As labs become more efficient, they often find that staff members have variation in resource demands at different times. Cross-training personnel can help alleviate bottlenecks. Some Foresight participants use cross-trained personnel to do triage for DNA cases and have reduced existing backlogs dramatically.

3. Communicate, communicate, communicate (and bring your DA donuts). During the Foresight project, we found that simply sitting together and sharing stories was a powerful way to learn. Our participants report that once they begin a conversation with their lab staff, they find everyone has great ideas for improvement, many that extend far beyond simple productivity tweaks. For example, one Foresight participant, an ex-detective, visits the local DA's office one morning a week. He brings donuts and spends a few hours asking about pending cases. He finds many have been settled and no longer require forensic intervention and thus has single-handedly reduced the lab's backlogs dramatically.

Communication extends beyond the DA's office. Many of our participants understand that legislative confusion leads to poor policy-making. One Foresight lab, for example, is required by law to conduct two separate tests for every DNA database entry, resulting in duplication of efforts when one test would have been sufficient. In this case, the foresight is actually in hindsight. Educating legislators can help alleviate problems before they even begin.

Other Foresight participants have leveraged the information collected via LabRAT to demonstrate both their efficiency and need for additional resources to their legislative overseers, avoiding budget cuts and, in some cases, securing much-needed additional resources.

4. Leverage technology. Sometimes personal intervention is not required. A Foresight participant used technology to reduce its backlog dramatically by tracking how many of its completed lab results reports were accessed and downloaded online. This lab discovered that 15% of the reports they had written were never used at all, uncovering a good deal of unnecessary work and adjusting their practices as a result.

pages of data for our initial evaluation. It was an onerous task, and we are forever grateful they were up to it. It helped us refine what we needed to collect, focusing on key metrics rather than the entire universe of information. It also exposed some unexpected areas for improvement, most notably in the area of language.

The Language Barrier

When we first began collecting data for Foresight, we ran into a few unexpected problems. When we talked about the most basic elements, such as a "case" or "test," we quickly realized that everyone in the room had a slightly different definition. As you can imagine, this posed some problems for accurate data collection. It was enlightening to learn that standard definitions didn't exist. We spent more than a year-and-a-half working out exactly what every term meant to be sure we were all speaking the same language. Our group of 15 or so scientists and lab directors from all across the United States and Canada were infinitely patient and willing. Sitting together every few months to discuss our goals, we were able to create succinct and agreed-upon definitions that formed the basis of our research data collection.

Developing Best Practices

Once we had definitions in place, we dove into the issues at hand. These issues were no different than the challenges that persist today: Reducing backloads, making sure each lab group had enough but not too many professionals to do the job at hand, ensuring the best mix of scientists/analysts/support staff, and dealing with generational and other interpersonal issues.

As a group we devised our first test instrument, incorporating budgetary measures by area of investigation, personnel statistics, training and tenure data, and casework data that include information on case type, number of test samples, and more. Our goal was to evaluate what constitutes best practices. This exhaustive process helped illuminate the key areas that affect performance and can be efficiently adjusted to provide an almost immediate, positive impact. This knowledge helped us create the much more concise collection tool we use to this day, LabRAT.

As today's participants enter data into the LabRAT spreadsheet, it calculates pertinent metrics the labs can use and track on a regular basis. This in itself is illuminating for some labs that may have access to the data through their LIMS systems but have rarely had the time to collect the information in such a coordinated and interlocking way. But what we find most interesting—and what draws many labs to the project—is the way our participant labs are using the data, how they are changing practices.

Real-world Results

Backlogs are a great example. Given the data we've collected over a wide sample population, we can quite confidently talk about where the greatest efficiencies lie and how to achieve these in the most expeditious way. We know where labs are performing particularly well. Take DNA for example. We found that once a lab corrects inefficiencies in workload, individuals in the lab from non-DNA areas of investigation often have additional downtime. Labs may use that downtime to train these folks to triage DNA casework, which leads to much better throughput in the growing demand for DNA casework. The cost is minimal—you're not adding any staff—and suddenly you're working through backlogs so quickly that you have additional time to focus on other cases. Given the large group of labs we've worked with, we have a good idea what size is optimal and can share this with each other to improve our work.

In addition to exposing areas for improvement, Foresight participating labs also enjoy the benefits of seeing where they fit within the larger group. This in and of itself can be enlightening. In some cases, a lab will find they may not be able to improve their efficiency beyond their current level. The data may show the lab is more costly than average in a particular area, but external factors like low crime rates (e.g., less need for a particular type of test) or higher compensation requirements due to geography have a significant impact. Uncovering this type of result is not necessarily a bad thing; however, lab personnel may want to think about outsourcing certain types of cases to adjust for this effect.

Resource Allocation

When it comes to cost, the Foresight model was designed to overlook nothing. When we talk about the cost of doing something, we look at everything from equipment, telecommunications, heating, lighting, facility rent … everything. If a participant doesn't have access to the data, we can estimate those costs from other labs in our studies. We come up with an all-inclusive figure that tells participants what it costs to process a case. This leads to informed decisions. Take trace evidence cases, for example. You might find that processing one trace evidence case costs the same as processing two, three, or even four traditional DNA cases. While trace evidence is wonderful and powerful, if DNA alone will get you where you need to be, this cost factor will heavily affect your decision-making process. Foresight is not about cutting where it matters. It's about using resources wisely so that labs can do more and enhance the services they provide. Once you know the key metrics, you can make informed decisions.

The results bear this out. For example, Foresight applies a testing intensity measure that provides a proxy measure for quality control. Generally, applying more tests in the same type of case is highly correlated with a reduction in risk or an increase in quality control—you are trying to reduce errors. However, you can test too much. Some labs found they were using legacy protocols that required they perform a presumptive test to determine if a sample was blood. But they quickly found that the next test performed both proved it was blood and added new information to the profile, so the presumptive test was unnecessary duplication. Testing too many times in a particular case takes away personnel, time, and funding that could be used elsewhere. Examining what you do and comparing it to what others do, essentially best practice benchmarking, can lead to some simple yet potent fixes.

Other labs have used the data collected via Foresight to justify budget increases or other improvements. In one of the more dramatic examples, a Colorado lab was able to secure an entirely new facility, and the Foresight metrics offered convincing evidence in support of its capital project. It's hard to argue with numbers. Our labs, and the labs' stakeholders, understand that by paying attention to business processes you can do more with what you have now, and when you request additional resources you can empirically prove it is to meet a real need and not because of any lingering inefficiency.

Having access to information is power. From backlogs to budgets, understanding and communicating your needs based on facts and backed up with figures helps forensic lab personnel achieve their goals and avoid potential pitfalls.

Interested in participating in the Foresight study?

Interested participants may e-mail Paul Speaker at paul.speaker@mail.wvu.edu for details. Public and private labs are welcome. Participants are required to share budgetary data regarding personnel, capital, consumables, and other areas, plus submit casework data. Participant names are not shared publicly, allowing labs concerned with privacy to maintain confidentiality.

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***Paul Speaker, Ph.D.**, is a faculty member of the West Virginia University Finance Department. He holds a Ph.D. and M.S. from Purdue University and a B.A. from LaSalle College. Dr. Speaker also holds the position of Chief Executive Officer of Forensic Science Management Consultants, LLC, a firm that specializes in the business of forensics using the forensics of business.*

***Tom Witt, Ph.D.**, is a faculty member of the West Virginia University Economics Department. He also serves as director of the WVU Bureau of Business and Economic Research and is an associate dean for research and outreach in the WVU College of Business and Economics. He holds a Ph.D. and M.A. from Washington University (St. Louis) and a B.A. from Oklahoma State University.*

Dr. Witt presented his findings from the Foresight project at the 2011 International Symposium on Human Identification (ISHI). Dr. Speaker will host a Foresight presentation at ISHI 2012, which takes place October 15–18 at the Gaylord Opryland Resort in Nashville, Tennessee (ishinews.com).

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Taking Control: Less Taxpayer Funding, but more DNA Testing

Through a local DNA database, Bensalem, Pennsylvania, has begun to leverage DNA in every possible case and has created a truly investigative tool.

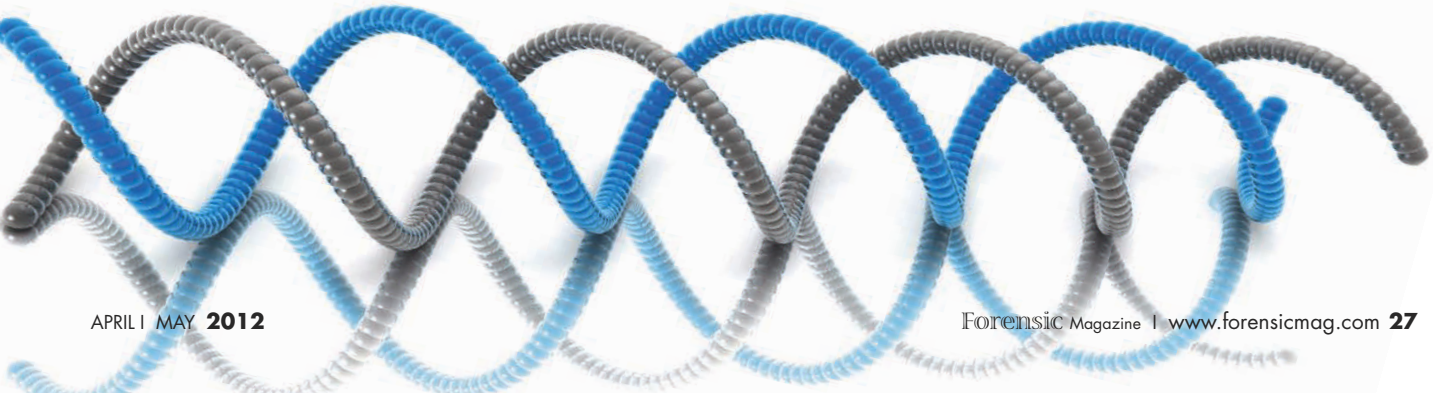
Earlier this year in Bensalem, Pennsylvania, a woman walked outside to find her car vandalized. It had eggs thrown on it and beer dumped all over it. It was washable, but nonetheless annoying and somewhat frightening. She believed that the perpetrator might well be her ex-boyfriend, not some random stranger or stalker; vandalism of a vehicle in the context of a "domestic" dispute. In other words, a guy throws some stuff on his ex-girlfriend's car—not the crime of the century. This isn't even the break-in of a home with hundreds of dollars worth of damage. In some jurisdictions, even if only due to limited resource constraints, this case might not receive the greatest attention.

But in Bensalem, no case is too minor to warrant consideration for DNA analysis. The vandal left two beer bottles on the car after emptying the contents onto the victim's hood. The bottles were collected and swabbed by the police. Note, the bottles weren't sent to the crime lab, they were swabbed by the patrol officer and the swabs were sent to the lab. As it turns out, the victim was exactly right, it was her ex-boyfriend who had vandalized her car.

Can you imagine being that defendant at the preliminary hearing? He shows up for what his cronies are saying is a case in which the ex probably won't even show up, and the DA says, "here's the DNA report." Even more, imagine the reaction of the defense attorney. I'm not even sure that CSI SVU, Miami, Las Vegas, or anywhere else has ever done a vandalism/ex-boyfriend show. Sure maybe a vandalized car with a dead body in the trunk or a serial vandal targeting high ranking officials or celebrities. But this was a "domestic," not a homicide, rape, or even burglary or car theft.

The reason is because Bensalem has gone "all in" with DNA. Having partnered with a private laboratory that also maintains its local DNA database, Bensalem has begun to leverage DNA in every possible case and has created a truly investigative tool. Having established a relationship with a fully accredited laboratory that guarantees a three week turnaround time and sends results directly to an officer's patrol car laptop, Bensalem has bypassed the restrictions and lag time that often accompany reliance on underfunded state laboratories. The Director of Public Safety, Fred Harran, has taken control of DNA's application, eliminated those roadblocks that prevent the effective and efficient use of DNA and is ensuring that, because DNA is being used quickly and often, the people of his community are safer. While recognizing the critical role that state laboratories play across the country, especially in more complex cases, Director Harran has taken ownership of the investigative potential of DNA.

Anytime law enforcement considers a new application of forensic DNA, one of the first questions asked by anyone responsible for its implementation has to be "How much is this going to cost me?" And for good reason: regardless of the cost/benefit value of DNA testing, the initial investment in any DNA testing project will be considerable. That was certainly the case when the Director was presented with the idea of using DNA and a local database to



solve property crime. Like most police executives, Director Harran quickly understood the basics: most crime is local and property crimes are our most recidivistic crimes. Therefore, a local database with a rapid turnaround time and results that can be quickly entered into that database had huge benefits. The faster he used DNA to solve his property crime cases, the faster he removed thieves and burglars from the streets of Bensalem. The sooner he did that, the more crime he prevented.

But Bensalem also came up with an approach to funding the program that doesn't cost taxpayers a dime and, to an extent, regenerates itself. The Director went to his drug forfeiture fund. The Department participates in a drug forfeiture program with the federal government. Depending on participation, that program returns 2% to 50% of all monies seized in joint narcotics operations back to Bensalem. In June 2010, the Director allocated about one and a half times the cost of a single new officer from his drug forfeiture fund to pay for a year of DNA testing at DNA SI Labs and for the creation of a local database to solve property crimes, car thefts, and drug cases. Not just any drugs cases, but those common and difficult cases in which a vehicle gets pulled over, five guys and a bag of heroin or crack are sitting in it, and everybody is pointing fingers at everybody else.

The program is not without its detractors—from both sides of the criminal justice system. The defense has obvious problems with the idea of establishing a local database that is not associated with CODIS (they object to CODIS too, but that's another article). In a flair of dramatic license, the name associated with them is "rogue" databases. But an electronic "database" is simply a mechanism to efficiently organize information that is otherwise legally obtained by police. CODIS simply does quickly what would take human laboratory analysts so much time as to make comparisons on a large scale virtually impossible. The constitutional issue arises in the context of taking the biological sample, not in its organization and application afterward.

Harran's system is based on constant monitoring and training of officers to ensure that samples are provided in a knowing and voluntary manner that meets Constitutional standards and protects citizens' rights. It is also based on constant training for the proper collection of samples from crime scene evidence. As stated in the first line of the Department's collection protocols:

> *It will be the policy of the Bensalem Township Police Department to establish a procedure for the collection, processing, and preservation of DNA evidence, while maintaining the professional integrity of this organization and the constitutional rights of the citizens whom we serve.*

The Department's leadership understands that their system must be based not only on the aggressive collection of crime scene samples but also on ensuring the validity of the voluntariness of samples collected from suspects. If the officers on the street get the consent wrong, if it's judicially deemed invalid, that may set a precedent difficult to retreat from. If the trial judges begin to think for a moment that Bensalem is acting beyond the scope of voluntary consent, the validity of their database will begin a descent into judicial scrutiny that could ultimately turn back the clock on the advances they are making.

But as I said, there has been opposition from both sides of the criminal justice spectrum. Many if not most public laboratories cringe at the idea of agencies developing their own databases and contracting with private labs for rapid turnaround time. The argument is simple: If agencies have financial resources available for DNA testing, why not have those resources go to the state or local government laboratory instead of the private sector. We are all in this together, aren't we? And that way the profiles, at least those profiles meeting CODIS requirements, could be entered into CODIS and law enforcement throughout the country would theoretically benefit. Some public labs have even suggested the possibility of directing specific agency funds specifically toward that agency's work, thereby potentially achieving the timeliness advantage achieved by the private sector.

All fair points. But there is no getting around the fact that the entry criteria for CODIS minimizes its potential for crime fighting and that the vast majority of crimes committed are localized in nature and not statewide or national. Further, the idea of sending funds from the police department back up through the state bureaucracy to fund a specific position, for a specific department's work, is fraught with potential dollar draining administration expenses likely to kill any attempts at cost efficiency. One of the points of outsourcing is savings on all the extras associated with hiring an individual human being.

To be clear, Bensalem in no way sees its program as a replacement for the state crime lab. The government laboratory system will always be the backbone of the forensic science system in the United States. The most serious, difficult cases are always going to be the responsibility of the government lab. And the majority of the offender databasing volume will be done by the government lab. But the Pennsylvania State Police would not

accept many of the suspect samples submitted by the department and any that were accepted would be waiting in a backlog of nine to twelve months. What Director Harran's program does is allow him to do more, a lot more and on his own dime. And when it comes to solving crime with DNA, more is usually better.

Here are a few examples of what Bensalem is doing:

One investigation into a suspicious individual loitering around a SEPTA bus station also yielded a handgun found on the bus, in a lunch box. Patrol officers (not the crime lab) swabbed the gun and a juice bottle also found in the box. The suspect also agreed to provide a buccal swab. In several weeks, not the nine to twelve months the state lab would have taken, the police had a match between the weapon and the juice bottle in the lunch box that also contained the gun. The results were fast. No state police resources had to be expended on the case and therefore could be allocated elsewhere. For that matter, no tax payer dollars were spent on the testing because drug forfeiture money is used. And there were no questions as to whether the suspect's profile could go into the state/national database. It goes into Bensalem's database and that is where they want it most.

In a possession of narcotics with intent to deliver case, the patrol officer, subsequent to a vehicle stop, discovered four bags of suspected heroin. Another officer swabbed the exterior of the bags and collected consensual swabs from both occupants of the car. Within weeks, (again, not months) and without taxpayer funding, a difficult constructive possession case turned into a strong case for the prosecution when the DNA from the baggie matched the DNA from one of the occupants. And when the car was forfeited pursuant to asset forfeiture laws, Bensalem generated more resources to do more DNA testing.

In the burglary of a construction company, equipment and a company truck were stolen. The truck was recovered a short distance away from the business and a patrol officer (not a crime scene specialist) swabbed the steering wheel for DNA. The previous year another patrol officer conducted a traffic stop of a suspicious vehicle and obtained consensual buccal swabs from the occupants whom he suspected were breaking into vehicles. The DNA obtained from the steering wheel in the burglary matched

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Synthetic Cannabinoids Pharmacology, 8am-11:30am

Tuesday, May 15
Overview of Lamp Filament Analysis, 8am-5pm
Paper Fundamentals for Forensic Document Examiners, 8am-5pm
Things that go Boom in the Night, 8am-11:30am
Expert Testimony, 1pm-5pm
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the profile of one of the individuals stopped previously. He was subsequently arrested and confessed to his involvement in the burglary. Again, no taxpayer dollars spent and a case solved in which the state CODIS agency would not have included the profile into their database but Bensalem's database removed the suspect from the street.

In a burglary/criminal trespass investigation, an officer collected a cigarette butt discarded by one of the actors. During a separate investigation and arrest, a voluntary buccal swab was obtained from an individual, the DNA of which matched the profile generated from the burglary investigation. There were no prior connections to or evidence against the defendant. Based on the DNA results and a subsequent interview with the defendant, two additional actors were identified and charged. A more traditional case similar to CODIS, but absent the voluntary, suspect swab taken and profile entered into the database, no match would have occurred. And again, no taxpayer dollars expended, state resources saved and multiple arrests.

The decision tree for whether to call in the crime scene unit and send evidence to the state lab or have patrol officers swab and outsource is a thoughtful one. It includes the seriousness of the offense and thus the need for the specialized expertise of the crime lab. It includes the need for timeliness—remember property crimes are our most recidivistic crimes and the longer we wait to solve them, the more people are victimized. And it includes whether the samples would be tested at all. But in Bensalem, the investigators make those decisions, no one else.

The Bensalem DNA program will come close to funding itself. The differential between the cost of the program and the funds taken in by drug forfeiture monies is more than made up for in the value of cases solved, man hours reduced, and most importantly, crimes prevented. Since the project was started in June 2010, Bensalem has already received hits on 57 cases on their local database. (They've had fewer than 12 hits through CODIS in the last two years.) Given recidivism rates for drug dealing and property crimes, that's a lot of crimes prevented.

The Director looks at the cost/benefit analysis this way: He costs out the expense of a new police officer at over $100,000 including salary, benefits, training, etc. "But a new police officer isn't going to solve nearly as many cases as a DNA databasing system with a fast turnaround time." Thus the investment in fast, local databasing becomes, as he says, "a no brainer." Especially considering that the database will only become more effective as the number of profiles increases. And when the DNA testing begins to pay for itself through forfeitures, the arithmetic is even more compelling.

The search for adequate DNA funding for most police departments isn't going to get easier anytime soon. But as this article went to print, Bensalem announced the arrest of six suspects in an $8 million cocaine ring drug bust. I think it just got easier for Director Harran.

Chris Asplen *consults with local, state, and foreign governments and law enforcement agencies on the use of forensic DNA technology. Chris is also the Executive Director of DNA 4 Africa and a member of the Crime Victim Bar Association. casplen@gth-gov.com*

Detective ***Sergeant William McVey*** *has been a police officer with the Bensalem Township Police Department since 1998. He has spent time in the patrol division as a field training officer, K-9 handler, and squad supervisor. He was reassigned to the detective division in 2008 and is currently responsible for the supervision of the department's Criminal Investigations Unit. Sergeant McVey is part of the team responsible for the development and current administration of the department's DNA program.*

Volumizing, Lengthening, Eye-Enhancing, and Crime-Solving?

The Forensic Potential of Mascara

Kristen Wiley

Trace evidence collection and analysis is an essential part of crime scene investigation. When properly isolated, characterized, and analyzed, these trace particles can place a victim or perpetrator at the scene of the crime or accident—evidence that has proven to be an important clue to solving many cases.

However, investigators tend to stick to the usual suspects when collecting evidence—fingerprints, hair, blood, and fibers—evidence that a clever criminal will try to obscure. When routine trace evidence collection fails to produce any leads, it is often too late to return to the crime scene. Viable evidence has a short life span and becomes compromised if it is not collected right away. As a result, valuable information becomes lost.

One type of evidence that is often overlooked by both collectors and perpetrators is eyelashes, more specifically those with mascara. Although eyelashes fall into the category of fiber collection, they are often deemed too insignificant to collect compared to human hair or clothing fibers. This lack of attention can result in missed opportunities.

The abundance of trace eyelashes, coupled with brand loyalty among mascara users, could provide investigators the ability to place a suspect or victim at the scene of the crime by identifying the personal brand of mascara used. When properly collected, extracted, and analyzed, mascara becomes another tool in the arsenal of a crime scene investigator.

The Power of Mascara Analysis

To better illustrate the forensic potential of mascara analysis, I created the following hypothetical investigation:

Three leads, suspect A, B, and C, have been identified based on the testimony of witnesses; however, all three suspects claim that they were never present at the crime scene nor had they ever come in contact with the victim. Evidence collected from each suspect's clothing included blood, hair, and eyelashes. After closer examination, analysts concluded that the blood and hair follicle belonged to each of the suspects. The eyelashes collected were the only piece of evidence left that required closer analysis.

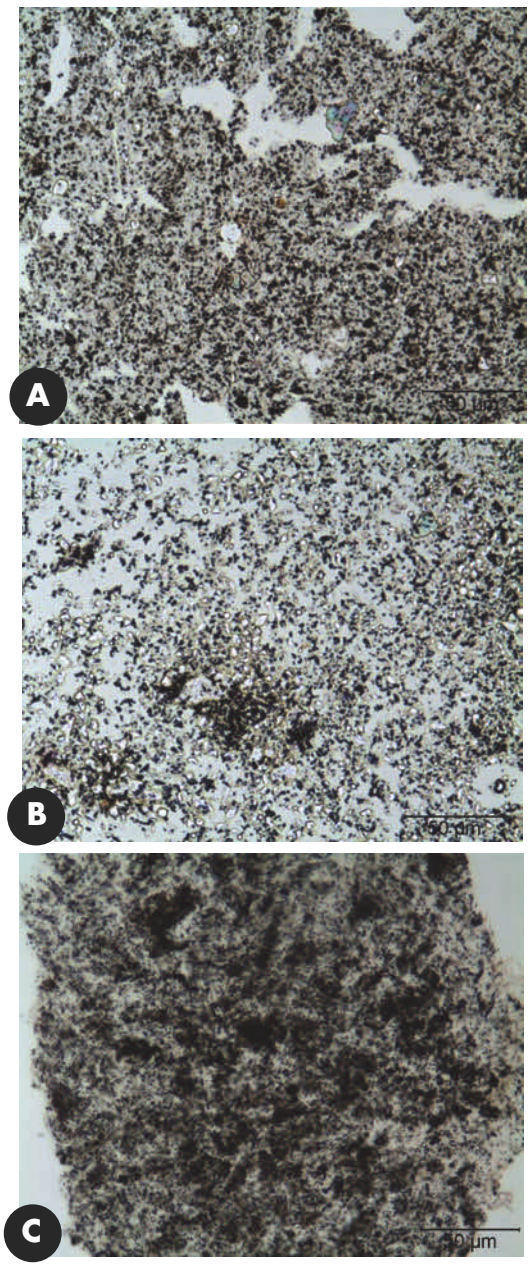

Image 1: PLM images from suspect A, B, and C. All in refractive index liquid n=1.662 at 500X.

The proximal ends (root end) of all three eyelash samples, collected from the suspects' clothes, were placed securely onto a piece of white, cleanroom tacky mat leaving the distal end exposed to a glass slide. Using a fine tungsten needle held at a very low angle, mascara was removed by gently rolling the needle along the length of the exposed hair. The needle was then rolled back over a clean glass slide, depositing any mascara. Deposits were then prepared on a micro potassium bromide crystal for infrared (IR) analysis and covered with a micro cover glass with refractive index liquid n=1.662 for polarized light microscopy (PLM).

Differences observed between each sample using PLM included binding material, optical properties, and birefringence. Differences in wavelength absorbance by IR were also seen.

Eyelash samples from the victim were then collected and analyzed following the same protocol. According to the data, the mascara removed from the victim's eyelash matched the mascara found on the eyelash collected from Suspect A.

Independent analyses of the three eyelash mascara samples were then compared to the mascara from the victims' personal mascara tubes and two other store-bought mascara brands. The eyelash mascara samples were given to the IR analyst as knowns, while the three samples from the tubes were given as unknowns. The IR specialist was able to easily match the mascara eyelash sample with the victim's brand of mascara. This additional analysis was done to further prove that the use of mascara was a valid technique in determining the presence of the suspect at the scene of the crime.

Forensic Implications

Any experienced crime scene investigator will tell you that it is the sum of the parts that lead to a conclusive determination. The combination of witness testimony, crime scene evidence, and thorough investigation is the only way in which to build a strong case.

Although mascara analysis alone is not enough to make a case, it provides an opportunity for investigators to link people to the scene of the crime. Available in three different forms (liquid, cake, or cream) with a plethora of options (color, strengthening, volumizing, lengthening, water-proof, etc.), the variety of combinations and brands make for hundreds of different types of mascara, each with its own unique chemical properties. Users typically stick to one brand at a given time; sometimes loyal customers will use a particular mascara for a lifetime. With the proper preparation and analysis, mascara can become a personal identifier.

Kristen Wiley *is a senior research microscopist at McCrone Associates, the analytical division of The McCrone Group. Wiley is also an instructor of sample preparation, isolation, and manipulation, and hair comparisons at Hooke College of Applied Sciences, the education division of the McCrone Group.*

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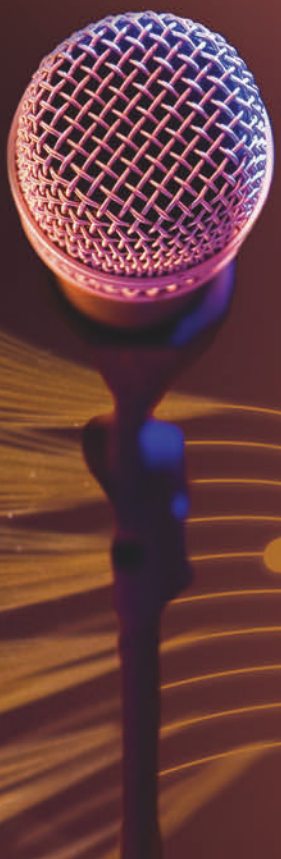

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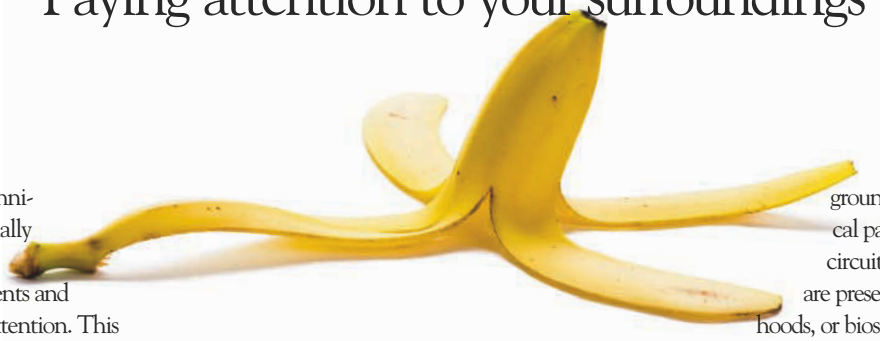

Working as a forensic technician is challenging, especially in terms of safety issues. So avoiding simple accidents and working safely warrants attention. This month the Safety Guys alert you to the potential significant physical hazards present at crime scenes and in the workplace. What do we mean when we say "physical hazards?" Obviously, they include conditions and situations that might lead to slips, trips, and falls as well as the constant threat of bites, scratches, and injuries from insects and animals. But, in addition to these common issues we want you to start thinking about the not so obvious hazards such as electrical safety hazards and high noise areas.

Let's Start With the Easy Stuff

Many injuries arise from poor housekeeping. Slips, trips, and falls are too common and easily avoided. Begin with organizing the storage areas. Be watchful not to create hazards with your material storage. Stack and interlock stored supplies, containers, and other materials that are tiered. Limit the height so that they are stable and secure against sliding or collapse. Minimize chaotic accumulation of materials in storage areas that could cause tripping, hinder access, or present a fire risk.

Next, perform a general facility inspection concentrating on walking/working surfaces, lighting, and egress pathways. It is imperative that emergency exit routes remain clear and unobstructed at all times. Make sure floors are smooth and free of cracks or lips that could catch or trip. Inspect storage racks, hand trucks, and other equipment to ensure good mechanical condition. Pay special attention to the castors. Note the lighting conditions and measure illumination in those areas that seem dim. Compare results to those recommended by IES and ANSI.[1] Ensure all lights within seven feet of the floor are protected against accidental breakage. Slip plastic protective tubes over florescent bulbs prior to mounting or install screens or plastic diffusers onto the fixtures. Finally, note areas with special lighting requirements and train employees to allow for eye adjustment before working in those areas.

You Might Be In For a Shock

While performing your facility inspection, keep an eye out for electrical hazards. Frequently found problems include improper use of extension cords or cords with cut, torn, or frayed insulation; exposed wiring; missing grounding plugs; open electrical panels; and over-loaded circuits. Less obvious hazards are present on work tables, fume hoods, or biosafety cabinets and wet vacuum systems. Pay close attention to wet areas. First, equip all electrical power outlets in wet locations with ground fault circuit interrupters, or GFCI, to prevent accidental electrocutions. GFCIs are designed to "trip" and break the circuit when a small amount of current begins flowing to ground. Wet locations include outlets within six feet of a sink, faucet, or other water source, and outlets located outdoors or in areas that get washed down routinely. Specific GFCI outlets can be used individually or install GFCI in the electrical panel to protect entire circuits.

Improper use of flexible extension cords is one of the most common electrical hazards. Extension cords should never substitute permanent wiring. Check the insulation and make sure it is in good condition and continues into the plug ends. Never repair cracks, breaks, cuts, or tears with tape. Either discard the extension cord or shorten it by installing a new plug end. Take care not to run extension cords through doors or windows where they can become pinched or cut. Use only grounded equipment and tools, and never remove the grounding pin from the plug ends. Do not hook multiple extension cords together to reach your work, just get the right length cord for the job.

Another thing to check is the electrical service panel or circuit breaker panel. Ensure a three-foot clear space is kept in front of these at all times. Also, clearly label each circuit breaker. Finally, if use of hanging pendants or electrical outlets is widespread in your work area, keep cords off floors and out of the way. Check pendants for proper strain relief, type of box, and guarding, if needed. In a recently visited facility, there was an accident from an unguarded hanging outlet shorting out when it was "caught" by a forklift passing under it. Fortunately, the forklift driver was not electrocuted.

Can You Hear Me Now?

Many crime scenes and other areas you might be working are inherently noisy. Excessive noise can result from traffic, construction equipment, or the machinery in use such as high-pressure air cleaning equipment and wet vacuum systems. Exposure to loud noise can result in loss of hearing. Noise-induced hearing loss is permanent and cannot be medically treat-

ed. This type of hearing loss is usually noticed by a reduced response to frequencies above 2,000 hertz (Hz). Since normal human speech is in the 2,000 to 4,000 Hz range noise-induced hearing loss is debilitating.

OSHA limits employee noise exposure to 90 decibels (dB) averaged over an eight-hour work shift measured on the A-scale and slow response with a standard sound level meter.[2] If noise levels exceed 85dB then the employer must implement a hearing conservation program (HCP) for exposed employees. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a more conservative threshold of 85dB as an eight-hour, time-weighted average (TWA).[3] Monitoring, annual audiometric testing, hearing protection, training, and record-keeping are required under the HCP.

A quick and useful method of checking areas for excessive noise is the "conversation test." Standing one to three feet apart attempt a normal conversation with another person. If conversation is difficult or impossible then the noise might be excessive. Have the areas evaluated by a qualified person knowledgeable in occupational noise, measuring techniques, data analysis, and control alternatives.

Control of excessive noise falls into three categories: engineering controls, administrative controls, and personal protective equipment. Under the OSHA standard, engineering controls are used first to control the hazard. This can include purchase of newer, quieter equipment, shielding, or installation of acoustical sound-deadening treatments on walls and ceilings. Administrative controls entail limiting the time an employee spends in the noise hazard area or assigning more than one employee to split the time to complete the task. The last line of defense for preventing excessive noise exposure is using personal protective equipment such as ear plugs or ear muffs.

We have touched on a few physical hazard areas that you can look into and make an immediate impact on your safety. Questions and comments are always welcome. E-mail us at thesafetyguys@forensicmag.com. Until next issue remember—SAFETY FIRST!

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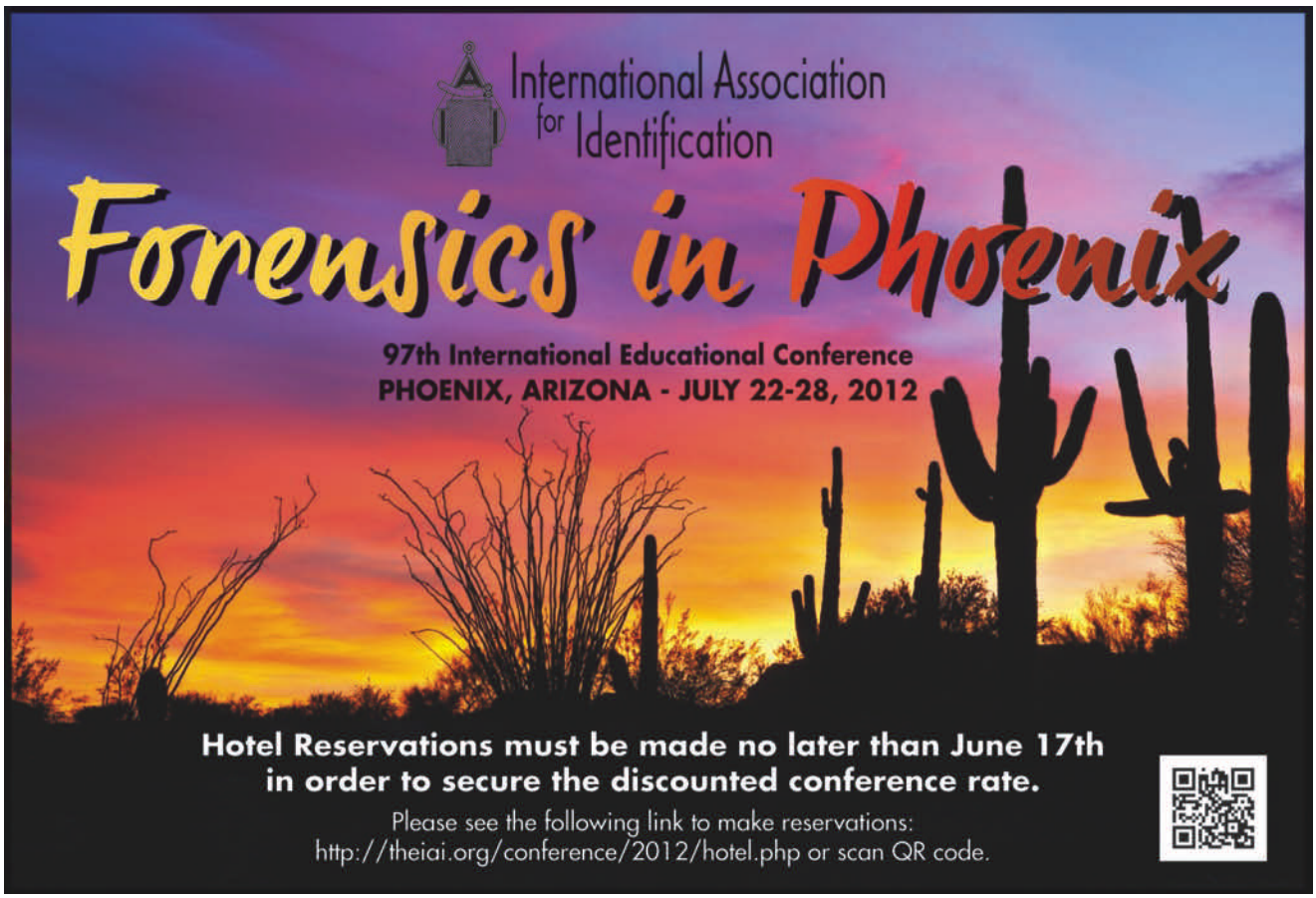
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Most wanted

Answers to Facility Issues

Susan Halla

Move Management and Your Laboratory:
You've Got to Move It, Move It!

One of the most difficult and time consuming portions of the construction of a new laboratory is preparing and orchestrating a move. Boxes. Packing. Accumulated ephemera from years of work. Cords and cables, obsolete instruments, old reagents—it's almost overwhelming to consider. While the idea of a new laboratory can be thrilling, the monumental task of the move can dampen some of the enthusiasm. Despite the trepidation, with some organization and forethought you can make the best of an inevitable situation. It is important to start early to plan for the process. Beginning to strategize about your move should begin as soon as you break ground on your building.

The first step is to determine who will be involved with the move. It is important to involve all staff in the move process, but utilizing key persons within your organization to act as move captains can be helpful, particularly if you have a larger staff. Begin by meeting with your move committee and determine key dates in the move process to disseminate to the remainder of the staff. Establish a regular schedule of move meetings to keep everyone in the loop and to address issues as they arise.

The first step in the move process is always spring cleaning or purging accumulated items. This is the perfect opportunity to assess reagents, instrumentation, files, and all of the "maybe-this-will-be-useful-someday" parts and pieces that have been shoved in closets, mechanical rooms, underneath tables, and in drawers and cabinets in the laboratories. If you don't need it, haven't used it, and don't want to use it, trash, recycle, or donate items.[1] Start an inventory chart in each section for items that will be moving to the new lab. If you already have an inventory chart, take this opportunity to update it. This list can be used as a checklist after the move for accounting purposes.

Designate certain days in your lab as move preparation days. If you have a dress code, relax it for those days so that your staff feels comfortable digging through those old closets and cabinets. Each individual staff member should be responsible for packing up his or her own personal effects. If you have a number of pack rats on your hands, you may want to consider limiting the number of boxes that each person can have for their personal effects.

Well in advance of the move, begin researching moving companies. You may want to establish an RFP (request for proposal) to find qualified movers for the process. Research their insurance and check their references. Understand what their insurance and bonding will and will not cover in the event of an issue. Remember to keep things in perspective when assessing quotes from your mover—will saving $200 on the move save you or cost you more in headaches and finger-pointing?

Consider how you will move case files and evidence to ensure chain-of-custody. If you are a facility which processes evidence from other jurisdictions, can you arrange for those jurisdictions to pick up and receive return custody of the evidence? How will you handle evidence or materials that need to maintain refrigeration or freezer temperatures? Do you need to consider refrigerated transportation?

Talk with the vendors and service companies who hold contracts on your instrumentation to find out what the particulars are regarding moves. Will they just calibrate/certify after the move, or do they need to crate, move, and uncrate

in order to indemnify you and guarantee your warranty? You may want to consider having your chosen moving company subcontract the specialty movers and thus be in charge of all of the coordination between the various groups to best orchestrate the timing. Have the moving company provide you with all of the moving necessities (boxes, tape, and labels) as early in the process as possible.

Along with your captains, establish a protocol for labeling equipment and boxes. This may be color-coding or a numerical coding that corresponds to room number. Whatever coding you choose, make sure to code both old and new areas. You may want to utilize the drawing plans to better demarcate areas for the moving team. Provide move captains on the day of the move at both the old and new locations—and make sure that those captains have been given the authority to make decisions for the move. Work with your IT department to make sure that you have established both phone and internet service in the new building prior to the move as you will need both for coordination purposes. You may also want to consider scheduling your move over multiple weekends to diminish the impact on your service to your jurisdiction or moving administrative items one weekend and laboratory items another.

Maintaining service levels and expectations with your local law enforcement and attorneys is another important aspect of move management. Make your intentions known early to your patrons: Will you still be processing casework throughout the move but at a reduced rate? Will you work with a partner laboratory to process casework for you for a period of time to accommodate the move? Make sure to notify those who will be impacted by your move and re-send a notice closer to the effective date.

Many laboratories will be purchasing new equipment that will be delivered to the new lab prior to the move. Is there any ability to use a training lab or QA lab in the new facility as a temporary mini-lab with the new equipment so that casework can still be processed? Remember to check your calibration and setup protocols to make sure that they are well defined prior to the move. Consider preparing and QCing as many reagents and test samples as possible for performance checks prior to the move so that you are not adding that additional burden after the move. For those instruments that do not require calibration by the vendor, consider scheduling preventative maintenance checks immediately after the move to head off any unforeseen instrumentation issues.

Beginning to strategize about your move should begin as soon as you break ground on your building

Once your move has occurred, consider holding an open house for your community and patrons—a new facility (and surviving the move) is a reason to celebrate. Last of all; be sure to thank your employees for a job well done.

Overall, remember to be flexible. Anticipate that aspects of the move will not go according to plan. Don't expect to move over the weekend and be up and fully operational. There will be kinks in the facility, kinks in your process, and kinks in the protocol, all of which take time to iron out. This may take weeks, months, or even a full year depending on the magnitude of your move. Start early, organize, prepare, do your homework, and remain calm, cool and collected and you will conquer the move process with flying colors.

Thank you to Jon Kokanovich and Barry Fisher (retired lab directors), Susan Shankles (Tucson Police Department Crime Laboratory), Heather Clines (NYC OCME), Steve Garrett (Scottsdale Police Crime Laboratory), and Allen Hamm (Johnson County Sheriff's Criminalistic Laboratory) for their contributions to this article.

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John J. Barbara

Windows 7 Registry Forensics: Part 4

Overview of Viewing and Capturing the Registry

There are several techniques that can be used to examine the Registry, each of which has its own merits. If time is of the essence (such as in an ongoing intrusion), an examiner could choose to access the Registry on a live system by using the computer's "regedit" command. Obviously, this will make a number of changes to the computer and does violate "the golden rule" of digital forensics. However, in doing so, the examiner might be able to quickly determine the extent of the intrusion. Alternately, the examiner could use a USB triage device containing tools to view the Registry directly (e.g. Registry Commander) or to export it for further examination (e.g. FTK Imager's "Obtain Protected Files" functionality). The USB device itself can also serve as the storage location for the exported Registry. Note, however, that attaching a USB device to a live system will update the Registry. Prior to using this approach, it is extremely important for the examiner to have verified on a test computer what Keys are affected when a USB device is attached to a live system. Likewise, the tools themselves need to undergo some sort of verification and/or validation process before being used for examination purposes. Documentation must be maintained in both instances to demonstrate that no probative information was compromised on a target system.

As previously mentioned, Registry Commander (which also provides the "Last Write Time" when a Key was accessed) can be used to manually examine the Registry on a live system. However, this could turn out to be a time consuming task. Another tool, such as Autorun, can be used to quickly provide a wealth of information about the Registry, such as what programs are configured to run during system bootup or login. Alternately, FTK Imager can be used to capture and export the Registry for a thorough offline examination using other tools such as RegRipper, WRA, Registry Viewer, KUSTAR, or Registry Report. Using either of these methods, the examiner will only be concerned with examining the Registry itself.

If time is not an issue, the examiner can perform a live acquisition of the computer's hard drive using a USB triage device containing an acquisition tool (e.g. FTK Imager's "Create Disk Image" functionality). During the acquisition, changes will be constantly occurring to the computer hard drive and to the Registry itself. Depending upon the circumstances, the computer could be powered down and its hard drive acquired post-mortem. In either instance, the image captured would have to be examined on a forensic computer using other forensic tools such as EnCase or FTK. The Registry could be examined manually or the files extracted and examined.

Registry Forensics: General Forensic Information

There are thousands of Keys in the Registry. Choosing which ones to examine would depend upon the type of investigation being conducted. As a simplified guide, many of the forensically important Keys can be grouped into several broad categories based upon what potential probative information they may provide: General Forensic Information, Attached Devices, Security Identifiers, and Intrusion Related Activities. (Note: the Keys discussed are by no means a complete listing and others not cited could be of importance.)

1. SYSTEM and USER INFORMATION:

HKLM\SOFTWARE\Microsoft\WindowsNT\CurrentVersion

Information about the version of Windows, the product key, the registered owner, the installation type, the system root directory, and other data are maintained in this Key.

2. LAST WRITE TIME:

Keys contain an associated Value called the "Last Write Time" (LWT) which is updated when a Key is created, modified, or accessed. Only the LWT of a Key can be obtained, not the LWT for a particular value. Knowing the LWT of a Key can infer the approximate date or time an event occurred. Although it may be difficult to determine what value was actually changed, it can help correlate the LWT of a Key and other information, such as MAC times found in the file system.

3. C:\PAGEFILE.SYS:

HKLM\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management

Virtual memory configuration is controlled by this Key. Only those parts of a program and data that are currently in active use are stored in RAM. Other parts are held in the "pagefile.sys." If the value of "ClearPagefileAtShutdown" in this Key is set to "1" then the "pagefile.sys" will be cleared upon system shutdown and potential probative information may be lost.

4. MOST RECENT USED (MRU):

HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\ LastVisitedPidlMRU

HKU\[SID]\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedPidlMRU

MRU lists contain entries that are made when a user performs a specific action such as running an application. These two Keys contain the names of recently used executable files and their folder paths.

HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePidlMRU

HKU\[SID]\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePidlMRU

These Keys and their Subkeys maintain lists of all recently opened or saved files (.pdf, .txt, .jpg, .doc, .docx, ppt, pptx, etc.).

HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\RunMRU

If a user enters commands into the "Run" dialogue box, an entry will be maintained in this Key.
HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs
This Key maintains a list of the last ten files that the currently logged on user accessed or executed via Windows Explorer and corresponds to the file listing found in "C:\Users\[Username]\Recent."

5. RECENT SEARCH TERMS:

HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\WordWheelQuery
HKCU\Software\Microsoft\Windows Search\ProcessedSearchRoots\0003\Default
When searching for files or folders using Windows Explorer, the first Key will store the search query. The second Key points to the default path where the searches are stored, generally "C\Users\[(User]\Searches\oneindex—[User SID]."

6. INTERNET EXPLORER:

HKU\S-1-5-21-1116317277-3122546273-4014252621-1000\Software\Microsoft\ Internet Explorer\Main
HKU\S-1-5-21-1116317277-3122546273-4014252621-1000\Software\Microsoft\ Internet Explorer\TypedURLs
The first Key stores the user's settings, information about search bars, start page, etc. and the second Key stores typed URLs entered into the address field. The last typed URL is "url1" and the first typed URL is "urlx" where "x" is the highest number in the list.

7. TIME ZONE INFORMATION:

HKLM\SYSTEM\ControlSet001\Control\TimeZoneInformation
HKLM\Software\Microsoft\WindowsNT\CurrentVersion\TimeZones
The Value "ActiveTimeBias" in the first Key represents the current time difference from GMT/UTC in minutes and the value "Bias" represents the difference in minutes between GMT/UTC) and local time. For example, Eastern Standard Time has a Bias property value of -300 (minus five hours difference). The second Key's Subkeys store information relating to all the various time zones around the world.

8. WINDOWS PROTECTED STORAGE:

HKCU\Software\Microsoft\Protected Storage System Provider
This Key securely stores the encrypted passwords for many applications. Passwords stored here can include those for Outlook Express (passwords created and maintained when the "Remember Password" option is selected), MSN Explorer (MSN Explorer's "Sign In" and "AutoComplete" passwords), and Internet Explorer (protected sites and "AutoComplete" passwords). Since these Values are encrypted, another tool (e.g. Cain & Able, PassView, IE PassView, PStoreView, etc.) would have to be used to (hopefully) decrypt and view the passwords.

This discussion will continue in the next Digital Forensics Insider column. (Note: Software tools mentioned in this column should not to be considered an endorsement of those tools by Forensic Magazine or by the author.)

***John J. Barbara** owns Digital Forensics Consulting, LLC, providing consulting services for companies and laboratories seeking digital forensics accreditation. jjb@digforcon.com*

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how it works

A New Standard in Tamper Evidence

PakLock tamper evident envelopes.

Problem: An obvious problem with existing tamper evident envelopes and bags, especially plastic-based ones, is that they are not entirely tamper evident. Tamper evident products are designed to indicate all opening attempts through trigger mechanisms that result in clear and apparent marks and signs. However, nearly every tamper evident security bag or envelope can be opened and resealed leaving virtually no trace of intrusion. This is done by making a small to medium size incision along the edge through only a single layer of the bag with a knife or scalpel, removing or altering contents, and then using an electric heat sealer to reseal the bag. Normally, parties that receive valuables or goods in tamper evident packaging are forced to use knives or sharp tools to open the bags which can lead to unintentional damage to the contents inside.

Additionally, existing tamper evident bags and envelopes are not sufficiently equipped with proper organizational features. Thousands of samples are lost or misplaced each year as crude practices such as labeling with a marker and masking tape or punching holes directly into the contents area of the bag for filing continue. It is the responsibility of every lab worker and technician to ensure that samples are properly packaged and stored in secure, dependable packaging.

Solution: PakLock, an Israeli company, has developed a line of tamper evident products that address the shortcomings of existing products. Employing patent pending heat-imprint technology, PakLock guarantees real tamper-evidence with a complete seal around the edges. As opposed to existing products with folded or straight-edge seals, PakLock employs a unique multidimensional 'wave' seal around all four sides of the bag or envelope. This unique sealing technique makes it impossible for intruders to open and re-close the edges of the bag without leaving obvious marks or signs.

Accompanying this seal is a perforated, tear-off bottom. By eliminating the use of a knife or tool to open the bag, PakLock's easy-open method not only negates the risk of workplace injury but also the chance of damaging the contents inside the package. This easy-open perforation can be adjusted to accommodate any weight load, relocated to either side or corner of the bag or be removed altogether. PakLock products are equipped with the highest standard smart security tape that indicates heat, cooling, peeling, solvent, and saliva attempts.

PakLock products can be customized according to size and shape. Bags, envelopes, and pouches range from as small as a 3″ by 3″ credit card to 42″ long by limitless widths. Fully equipped with ample space for labeling, 1–4 tear-off receipts, sequential numbering, barcodes, and proper filing holes, PakLock products offer an advanced tamper evident security product. This product line is designed to cater to a wide range of forensic uses and is therefore available in almost any type of material including, but not limited to: polyethylene, Tyvek, micro-perforated PE, Kraft paper, mesh netting, and bubble-liner.

For departments sending and receiving large volumes of evidence and samples, PakLock has developed an automatic security sealing machine. The on-site machine is loaded with rolls of PakLock bags that already have three sides sealed with the 'wave' seal. Samples or evidence are loaded onto a tray that automatically inserts the contents into the bag. Instead of closing the bag with security tape, the machine heat seals the final side of the bag with PakLock's multidimensional seal for a stronger, more secure package.

Existing tamper evident products fail in meeting basic functions, particularly with regard to security. It is important for forensic departments to stay informed about the most up-to-date means of ensuring the highest standards of quality. Given the value attributed to forensic evidence and DNA in criminal investigations and judicial processes, maximal security is necessary.

For more information, visit www.paklock.com.

Who says you Can't do that?

Dick Warrington

Setting the Standard: Maintaining Professionalism

In the last issue, we looked at a variety of ways to save money while still doing the job well. With the economy still sputtering, some may end up cutting corners to save a buck. But such actions can be counterproductive and costly in the long run. In this column, we'll look at some ways to set a high level of professionalism even when you're watching the bottom line.

1. Plan for a Jury Trial

One of the biggest mistakes CSOs make is entering a crime scene without a plan. Whenever you work a case, always assume that it'll be going to a jury trial. Imagine that you're called to a scene and you decide that it's a suicide. Because you don't expect a trial, you don't process the scene in the way you would if you were going to court. But what if new evidence turns up later indicating it was a homicide? By then it'll be too late. In other instances, you may think you're working a simple case but your robbery or arson is actually connected to other cases. If you haven't done a thorough job at your scene, you may not be able to make these connections in court.

While your plan will vary to a certain extent depending on the exact nature of the scene, it will always be driven by the same goal: preparing the best case for trial. With that idea in mind, you know you'll need to process the scene carefully, collect as much evidence as possible, process that evidence, and document it. Always photograph your evidence before you process it, and remember to include the appropriate scales and markings. Document all footprints and tire tracks. Such evidence can be crucial in both eliminating and identifying suspects. Also document the suspect's method of entry and exit. This type of evidence can also be important to your case.

While we're on the topic of documentation, don't forget that all photos must be turned over to the defense, even if those photos include people clowning around. You can be sure the defense will use these photos to imply that your opinion is that the case is a big joke. Photograph only what's relevant to the case. The same goes for video—shoot only what's needed for the case. If possible, shoot video without the audio to eliminate background sounds and other distracting noise.

2. Strive for Consistency

Being consistent can greatly increase your level of professionalism. Establish a system for documenting, marking, and recording evidence, and then use this system every time. For example, when you collect clothing evidence, always mark it in the same place and with the same type of information (your name, the case number, the date, etc.)

Using this kind of system can help you work more effectively and efficiently. Once you master the system, you won't have to think about it. And when your case does go to court, you'll be ready. When you're testifying in front of the jury, you want to be clear and confident. If you haven't taken the time to develop a good system, you may find yourself fumbling around on the stand trying to find the place where you marked the evidence or, once you finally find the mark, struggling to decipher what you wrote. Don't let that happen to you.

3. Focus on the Details

Paying attention to details can make all the difference in your case. Be careful to avoid short cuts or inexpensive options that end up costing you. Here are some examples:

When collecting evidence, it's tempting to grab some grocery bags from your car. Don't fall into this trap. Always use clean, new bags for evidence, or your evidence will be worthless.

Earlier, I mentioned the importance of using a scale with your photos. Again, it's tempting to grab whatever's handy. But your presentation will look a lot more professional if you use a standard ruler marked in inches and centimeters.

You often need to indicate things like a bullet hole or blood spatter at a scene. Many CSOs will simply point to these items, but you can add to the quality of your work by using adhesive markers. (Download free markers at www.csigizmos.com.)

When you collect evidence and bag it, seal the bag with tape and then sign your name across the tape. This will be a visual record that you collected the evidence, and it will also prevent anyone from disturbing the evidence. Plan ahead and order evidence tape with your department's name on it—no extra charge, but added professionalism.

Before you lift prints, say from a car or other vehicle, draw brackets around the prints with a dry erase marker. Write down the pertinent information next to the print (ID, your initials, date, case number). You can also indicate orientation, which can be crucial to your case. When you lift the print, the dry erase markings will also come on to the backing card.

These days, many departments are facing serious financial challenges. CSOs need to look for ways to save money while still maintaining high professional standards.

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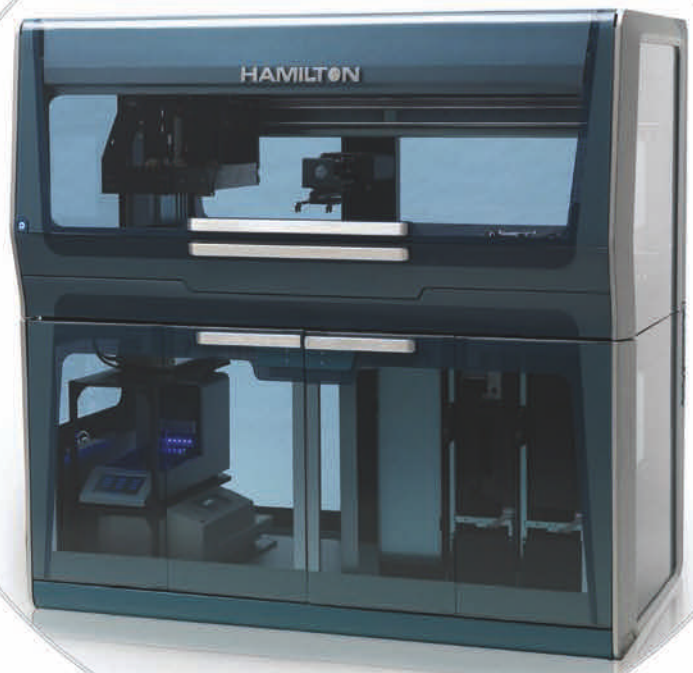

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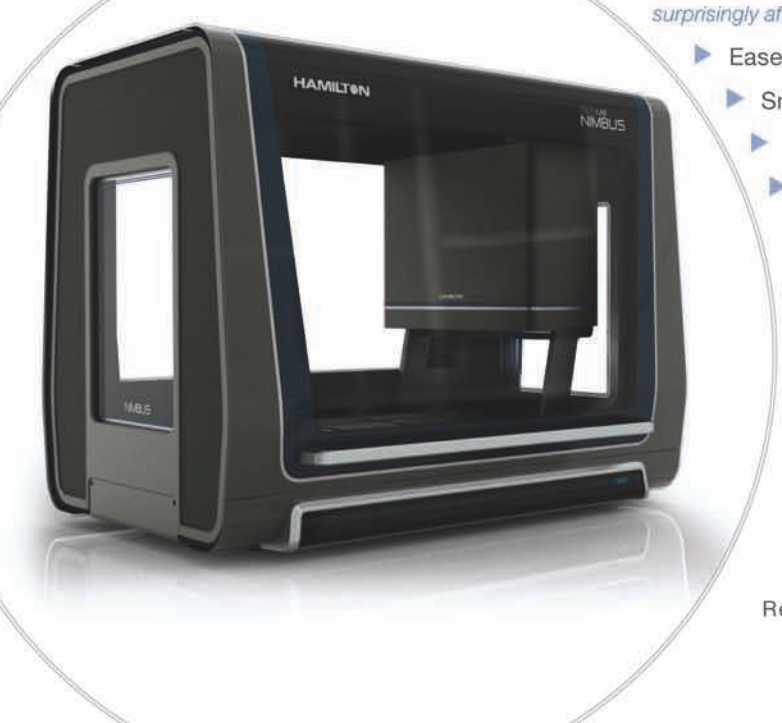

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